Coffee Market Performance and Producer Welfare Upon the Introduction of the Ethiopian Commodity Exchange

TINSAE DEMISE

Promoters: **Prof. dr. ir. Marijke D'Haese**

Prof. dr. ir. Wim Verbeke

Dean: **Prof. dr. ir. Marc Van Meirvenne**

Rector: **Prof. dr. Anne De Paepe**

MEMBERS OF THE JURY

Prof. dr. ir. Koen Dewettinck (Chairman)
Ghent University
Department of Food Safety and Food Quality

Prof. dr. ir. Pascal Boeckx (Secretary)
Ghent University
Department of Applied Analytical and Physical Chemistry, ISOFYS

Prof. dr. ir. Marijke D'Haese (Promoter)
Ghent University
Department of Agricultural Economics

Prof. dr. ir. Wim Verbeke (Promoter)
Ghent University
Department of Agricultural Economics

Prof. dr. ir. Jeroen Buysse
Ghent University
Department of Agricultural Economics

Dr. Kindie Getnet
International Food Policy Research Institute, Dhaka, Bangladesh

Dr. ir. Valeri Natanelov
Grow-a-bric

TINSAE DEMISE

Coffee Market Performance and Producer Welfare Upon the Introduction of the Ethiopian Commodity Exchange

Thesis submitted in the fulfillment of the requirements for the degree of Doctor (PhD) in Applied Biological Sciences

This research was funded by a PhD grant of The Netherlands Organization for International cooperation in Higher Education (NUFFIC)

Dutch title:

Prestatie van de koffiemarkt en welvaart van de producenten na de invoering van de Ethiopian Commodity Exchange

Acknowledgments

At the outset, I would like to praise the Almighty God who always let the bulk of unfinished work to be completed at a moment. I am grateful to my respected promoters, Prof. dr. ir. Marijke D'Haese and Prof. dr. ir. Wim Verbeke for their unreserved advice, guidance, and constructive criticism starting from the very commencement up to my PhD completion. Without their encouragement, insight and professional expertise, the completion of this work would not have been possible. I also would like to express my gratitude to Dr. ir. Valéri Natanelov, for your support during the last four years. You were the one who introduce me to the world of time series econometrics. I furthermore wish to express my sincere gratitude to the members of the jury a for their comments and advise to improve the quality of this dissertation.

A special thanks to Firew Demise. Thank you for your assistance, encouragement and precious time you spent on sharing my burden in all my way. Thank you brother. I am indebted to many individuals for their help and encouragement rendered while conducting this study. I would also like to thank all of my colleagues at Jimma University for all your supports.

Thanks to all colleagues at the Department of Agricultural Economics. I will always remember all the happy moments I had with you, drink after work, board game, sport events, special dinner…My special thanks extend to my officemates Lotte, Eline and Annelien who made my Gent stay as pleasant as possible.

I would like to thank the Netherlands organization for international cooperation in higher education (NUFFIC) for the financial grant to do my PhD work. My deepest gratitude goes to Mr. Jaspers Carel who has been easing all of my financial matters. My PhD would have been quite a long journey without the help of the project management team from the North (Q-point, Netherland) and Jimma University (Dr. Derbew Belew, Mr. Getachew Negussie and Mrs. Selamawit Teshome)

I am very grateful to my parents for their incessant moral support. The generous support and encouragement of my mother Aregash Abiyo and my father Demise Handino, all closest families and relatives are deeply acknowledged and emphasized in all cases of my future life.

Table of Contents

List of tables

List of figures

List of abbreviations

ADF	Augmented Dickey–Fuller
AIC	Akaike Information Criterion
ARCH	Autoregressive Conditional Heteroscedasticity
ARDL	Autoregressive Distributed Lag
ATT	Average Treatment Effect on the Treated
BEKK	Baba-Engle-Kraft-Kroner Models
CIA	Conditional Independence Assumption
CLU	Coffee Liquoring Unit
CR4	Four-Firm Concentration Ratio
CR8	Eight-Firm Concentration Ratio
CSA	Central Statistical Agency
CSC	Common Support Condition
CUSUM	Cumulative Sum
DCC	Dynamic Conditional Correlation
DST	Direct Specialty Trade
ECEA	Ethiopian Coffee Exporters Association
ECM	Error-Correction Model
ECT	Error Correction Term
ECX	Ethiopia Commodity Exchange
ENSO	El Nino Southern Oscillation
eTRADE	Electronic Trade
FDRE	Federal Democratic Republic of Ethiopia
FOB	Free on Board
ICO	International Coffee Organization
IFPRI	International Food Policy Research Institute
LM	Lagrange Multiplier
IMF	International Monetary Fund
KM	Kernel Matching
MGARCH	Multivariate Generalized Autoregressive Conditional Heteroscedasticity
MoFED	Ministry of Finance and Economic Development
MS-HTE	Matching Smoothing-Heterogeneous Treatment Effect
MWALD	Modified Wald
NARDL	Nonlinear Autoregressive Distributed Lag Model
NGO	Non-Governmental Organization
NN	Nearest Neighbor
NP	Without Parchment
OLS	Ordinary Least Squares

P	Parchment
PSM	Propensity Score Matching
SAP	Structural Adjustment Programs
SBC	Schwarz's Bayesian Criterion
SM-HTE	Stratification Multilevel-Heterogeneous Treatment Effect
UG	Under Grade
UNESCO	United Nations Educational, Scientific and Cultural Organization
USAID	United States Agency for International Development
VAR	Vector Autoregression
VECM	Vector Error-Correction Model

Summary

Summary

Market policy reforms in the ever-changing global commodity market are needed to accommodate the needs arising from the domestic economy but also for a sector to sustainably integrate in a globalized commodity market. This doctoral thesis focuses on policy reforms in the Ethiopian coffee sector that aim to support marketing institutions in the creation of national and local value chains that serve all stakeholders. This doctoral thesis examines how the establishment of the Ethiopian Commodity Exchange (ECX) impacted on the coffee sector. It focusses on the integration of prices of coffees from different Ethiopian origins (a) with prices on the international market, (b) between the different local markets and (c) between the different actors in the Ethiopian coffee chains. It also studies how farmers could benefit from integration within traceable export chains that are organised at a cooperative level. The specific objectives are to analyse the cointegration of Ethiopian coffee prices with the international markets under quality differentials, the extent of spatial price integration of major coffee-grower markets in Ethiopia, the price relationship between the different actors in the Ethiopian coffee chain, and the welfare impact of de-commoditisation on coffee producers marketing through membership of traceable coffee cooperatives.

The thesis starts by giving an overview of the Ethiopian coffee market by introducing the different market actors and their role and the main characteristics of the different Ethiopian coffee types.

Chapter 3 focusses on the relationships between the prices of Ethiopia coffee types and the international coffee prices. It compares these relationships for the prices before and after the ECX was established. The study used the Pesaran et al. (2001) autoregressive distributed lag model (ARDL) and the Shin et al. (2014) nonlinear autoregressive distributed lag model (NARDL) to analyse the cointegration of the various Ethiopian origin coffees and with the prices of the different Arabica natural and Robusta coffees on the international market. Results show that during the pre-ECX period (January 1998 - November 2008) all types of Ethiopian origin coffees established a long run cointegration with the prices of Arabica coffees on the international markets. Similarly, in the post-ECX (December 2008-May2013) period prices of all types of Ethiopian coffee

except Harar coffee cointegrated with the international prices of the Other Milds, Colombian Milds and Brazilian naturals. These results suggest that Ethiopian coffees adjusted most to the price changes of Colombian Milds and Other Milds coffees, except for Harar coffee. The study also finds that prices of Ethiopian origin coffees that fetch lower prices on the international markets adjusted more slowly to changes in prices of all Arabica coffees in the pre-ECX period and coffees known for their better quality seemed to adjust faster. This changed in the post-ECX period and the reaction time taken to correct the disequilibrium error was shorter for coffees that fetch lower prices and longer for prices of premium and higher priced Ethiopian coffees. The price of Harar coffee was not cointegrating with the prices on the international market which was ascribed to the particular market on which Harar coffee was sold.

The fourth chapter was set out to investigate if the levels of spatial coffee market integration in Ethiopia changed between pre-ECX (1998-2008) and post-ECX (2008-2013) periods. The study specifically examined the extent to which, despite there being a prohibition arbitrage trade between producer markets of different origins, the establishment of the ECX increased the integration of domestic coffee markets. The cointegration results suggest that between 2008 and 2013 producer markets integrated more within their own region rather than that a national harmonization was created. The prices on the producer markets in southern and southwestern Ethiopia cointegrated more amongst each other than they did with markets in other regions. In the post ECX period, even though it was limited, an opportunity was created for lower priced coffee producing markets to establish themselves in the market. However, the market was dominated by the high-quality coffee producing markets.

The objective of the fifth chapter was to empirically investigate the market integration and price transmission asymmetry for the five major types of Ethiopian coffee along the coffee value chain after the establishment of the ECX. The study considered the formation of the ECX as a step towards the establishment of an institutionalized Ethiopian coffee market. Results from an NARDL model showed that there is an asymmetric price relationship for higher quality coffees (Harar, Sidama and Yirgacheffe) at different level of the market. This may be due to the market power of a small number of large companies

at the export level. However, frequent transmission towards producers is observed when there is a price decrease.

The question whether producers who market coffee through certified (and hence traceable) chains were better off was examined in chapter six. A Propensity score matching model using primary data collected amongst members and non-members of certified cooperatives showed that engagement in the certified and traceable coffee channels enabled producers to fetch a better and more stable price for their wet-processed coffee supply. Yet, this higher price was not sufficient to substantially increase coffee income. Net cash returns from coffee and production costs on inputs and labour were not significantly different. Despite the sustainable production activities adopted by the members of the certified cooperatives, their coffee yields were relatively lower amongst cooperative members compared to the farmers in the control group. Finally, the study showed that the heterogeneity impact of being a member of a certified cooperative.

Generally, ECX is a great milestone for a developing country economy such as that of Ethiopia which encountered numerous socio-economic problems. However, the ECX faces challenges in achieving the institutionalization of the Ethiopian coffee market. There are two points that this study considers most critical in the overall institutionalization process of ECX. The first point is ECX's failure to understand the coffee market, in which ECX has been treating coffee as a commercial commodity. It is believed that the commoditization of coffee emanated from the intense need of foreign currency, which pose a challenge towards the sustainability of coffee sector. The second point is that, ECX has been working to create a transparent and accountable marketing institution for the stakeholders in the coffee market, but the lack of institutional trust at all levels, especially at higher-level of Ethiopian coffee market need due consideration.

Table 0.1 Summary of the core findings

Pre ECX	Post ECX
• All Ethiopian coffees integrated with prices of Arabica coffee • Prices of lower-priced Ethiopian coffees adjusted slowly to Arabica coffee price changes • Prices of better quality Ethiopian coffees adjusted faster to Arabica coffee price changes	• Prices of all Ethiopian coffees except Harar integrated with prices Arabica coffee • Prices of lower-priced Ethiopian coffees adjusted faster to Arabica coffee price changes • Prices of better quality Ethiopian coffees adjusted slowly to Arabica coffee price changes
• Mixed pattern of spatial integration • Markets of relatively lower quality coffees integrated within their regional market	• More regional integration than national harmony • Harar coffee dominated the market • Relatively lower quality coffee able to integrate with high price coffee

After ECX

Producer - ECX

	Symmetric/Asymmetric **Short run**	Price Adjustment	Symmetric/Asymmetric **Long run**	Price Adjustment
Harar	Asymmetric	**Increasing**/decreasing	Symmetric	-
Jimma	Symmetric	-	Symmetric	-
Sidama	Symmetric	-	Symmetric	-
Wollega	Symmetric	-	Symmetric	-
Yirgacheffe	Symmetric	-	Symmetric	-

Producer – Export

	Symmetric/Asymmetric **Short run**	Price Adjustment	Symmetric/Asymmetric **Long run**	Price Adjustment
Harar	symmetric	-	Asymmetric	**Decreasing**
Jimma	Asymmetric	**Decreasing**	Symmetric	-
Sidama	Asymmetric	**Decreasing**	Asymmetric	**Increasing**
Wollega	Symmetric	-	Symmetric	-
Yirgacheffe	Symmetric	-	Asymmetric	Increasing/**Decreasing**

ECX – Export

	Symmetric/Asymmetric	Price Adjustment	Symmetric/Asymmetric	Price Adjustment
	Short run		**Long run**	
Harar	Asymmetric	**Decreasing**	Symmetric	-
Jimma	Symmetric	-	Symmetric	-
Sidama	Symmetric	-	Symmetric	-
Wollega	Symmetric	-	Symmetric	-
Yirgacheffe	Symmetric	-	Symmetric	-

De-commoditisation impact through certified cooperatives

- Better and stable price for wet processed coffee
- Did not change coffee income
- Lower coffee yield
- Higher level of wet processed coffee supply
- Highly engaged in sustainable coffee farming
- Heterogeneity between member of certified coffee cooperatives

Samenvatting

Hervormingen in het marktbeleid zijn noodzakelijk in de steeds veranderende globale markten van basisproducten, dit om enerzijds aan de noden van de lokale economie te voldoen maar ook om een sector duurzaam in deze globale markt te integreren. Dit doctoraat focust op beleidshervormingen in de koffie sector in Ethiopië die als doel hebben om markt instituties te ondersteunen zodat waardeketens worden gevormd waarin alle actoren worden ondersteund. De thesis bestudeert hoe het oprichten van de Ethiopian Commodity Exchange (ECX) een impact heeft gehad op de koffie sector. In de verschillende hoofdstukken wordt bestudeerd hoe de prijsintegratie van de Ethiopische koffie ten opzichte van de internationale markten alsook binnen Ethiopië en tussen actoren in de keten werd beïnvloed door het oprichten van de ECX. Daarnaast wordt ook bekeken hoe producenten baat kunnen hebben bij het integreren in andere ketens dan de ECX, zoals de gecertificeerde coöperatieven waar de koffie wel traceerbaar blijft. De specifieke objectieven van deze studie zijn het bestuderen van: de cointegratie van de prijzen van Ethiopische koffie uit verschillende oorsprongsgebieden in het land met prijzen voor koffie op de internationale markten; de spatiale prijsintegratie tussen de verschillende oorsprongsgebieden van Ethiopische koffie; de transmissie van prijzen doorheen de ketens in de verschillende oorsprongsgebieden en de welvaartsimpact voor de producenten van de verkoop van koffie via alternatieve kanalen dan de ECX met name via coöperatieven die gecertifieerd zijn waardoor de verkochte koffie traceerbaar wordt.

De thesis start met het geven van een overzicht van de Ethiopische koffiemarkt door de verschillende actoren in de markt en hun rol te beschrijven alsook door de belangrijkste karakteristieken te belichten van de koffie uit de voornaamste oorsprongsgebieden.

Het eerste empirische hoofdstuk focust op de relatie tussen de prijzen van de koffies uit de verschillende Ethiopische oorsprongsgebieden en de internationale koffieprijzen. Het beschrijft deze relatie voor de prijzen voor periodes voor en na de invoering van de ECX. Het maakt gebruik van een autoregressive distributed lag model (ARDL) van Pesaran et al. (2001) evenals het nonlinear autoregressive distributed lag model (NARDL) van Shin et al. (2014) om de cointegratie te testen tussen de prijzen van

de koffies van verschillende oorsprongsgebieden in Ethiopië met deze van verschillende Arabica en Robusta koffies op de internationale markt. De resultaten geven aan dat in de periode voor de invoering van de ECX, de prijzen van koffies van alle Ethiopische oorsprongsgebieden integreerden met de prijzen van Arabica koffies in de internationale markten op lange termijn. Een gelijkaardig niveau van prijsintegratie werd gevonden voor de prijzen Other Milds, Colombian Milds en Brazilian naturals op de internationale markten en de prijzen van Ethiopische koffie behalve deze van Harar na de invoering van de ECX. De resultaten geven ook aan dat de prijzen van de Ethiopische koffies (behalve Harar koffie) zich vooral aanpassen aan prijsveranderingen van Colombian Milds en Other Milds koffies. De studie toont dat de prijzen van de Ethiopische koffies van oorsprongsgebieden die aan lagere prijzen worden verkocht, zich trager aanpassen aan de prijsveranderingen van alle Arabica koffies in de periode voor de invoering van de ECX, en de koffies die gekend zijn om hun betere kwaliteit zich sneller aanpassen. Voor de prijzen genoteerd na de start van de ECX was dit anders, en de reactietijd na een prijsonevenwicht was korter voor de lager geprijsde Ethiopische koffie en langer voor de premium Ethiopische koffies. De prijs van Harar koffie cointegreerde niet met de koffieprijzen op de internationale markten wat terug te brengen is tot de andere markt waarop Harar koffie wordt verkocht.

Het vierde hoofdstuk bestudeert of de spatiale integratie tussen de verschillende koffiemarkten in Ethiopië is veranderd tussen de periode voor de invoering van de ECX (1998-2008) en de periode er na (2008-2013). Het hoofdstuk analyseert of de invoering van de ECX en het verbod om koffie te verhandelen tussen de oorsprongsgebieden, een mogelijk effect hadden op de prijsintegratie tussen de verschillende Ethiopische koffies. De resultaten geven aan dat de markten in de verschillende oorsprongsgebieden meer op regionaal niveau cointegreerden dan op nationaal niveau. De prijzen van de koffie op de markten in Zuid en Zuidwest Ethiopië cointegreerden meer onderling dan dat ze deden met markten in andere oorsprongsgebieden. In de periode na de invoering van de ECX, werd tot op een zeker niveau een mogelijkheid gecreëerd dat de koffie uit oorsprongsgebieden waarvoor de prijzen laag zijn, zich kon plaatsen in de markt. De markt blijft evenwel gedomineerd door de prijzen van koffies uit gebieden die gekend zijn voor een hogere kwaliteit.

De doelstelling van het vijfde hoofdstuk was om empirisch de marktintegratie en de prijs asymmetrie tussen de actoren in de koffie ketens uit de vijf belangrijkste oorsprongsgebieden in Ethiopië te bestuderen na het opstarten van de ECX. De studie nam aan dat de opstart van de ECX een mogelijke stap was naar het institutionaliseren van de Ethiopische koffiemarkt. Resultaten van het NARDL model tonen aan dat er een asymmetrische prijsrelatie is voor koffies uit oorsprongsgebieden gekend voor hun hogere kwaliteit (Harar, Sidama and Yirgacheffe) tussen de verschillende actoren in de keten. We vermoeden dat het relatief kleine aantal weliswaar grotere exportbedrijven hierin een rol speelt. Vooral een daling van prijzen wordt doorgegeven tot bij de producent.

De vraag of producenten die hun koffie verkopen via ketens die gecertifieerd zijn (en dus traceerbaar) hiervan baat kon hebben, werd in hoofdstuk zes behandeld. Een Propensity score matching model, gebaseerd op data die werd verzameld bij leden en niet-leden van gecertifieerde coöperatieven, toont aan dat leden een betere en minder variabele prijs konden krijgen voor de gewassen koffie. Toch was deze hogere prijs niet voldoende voor deze boeren om een hoger inkomen te generen uit de verkoop van hun koffie. De netto-cash winsten van koffie en de productiekosten van grondstoffen en arbeid bleken niet te verschillen tussen de groepen boeren. Ondanks dat bepaalde duurzaamheidsparameters beter waren voor de leden van de gecertifieerde coöperatieven, was de gemiddelde koffie opbrengst per hectare lager bij leden van de gecertifieerde coöperatieven ten opzichte van de niet leden. Tot slot toonden de resultaten dat er een heterogene impact is tussen de leden van de gecertifieerde coöperatieven.

Over het algemeen, kan het opstarten van de ECX als een belangrijke mijlpaal worden gezien voor een economie in een ontwikkelingsland die geplaagd wordt door meerdere socio-economische problemen. Toch zijn er een aantal uitdagingen voor ECX om een geinstitutionaliseerde koffiemarkt te laten ontstaan in Ethiopië. Er zijn twee punten die doorheen de studie bijzonder moeilijk bleken. Ten eerste blijkt het voor de ECX moeilijk om de koffiemarkten goed te verstaan. De ECX behandelt koffie als een basisproduct. Het blijkt dat de commodificatie van koffie voornamelijk voorkomt door de grote nood aan deviezen, wat dan evenwel een belangrijke uitdaging blijkt voor een duurzame koffiesector. Ten tweede blijkt dat de ECX werkt aan het creëren van een

transparte en toerekeningsvatbare koffiemarkt voor alle actoren, maar dat vooral het institutioneel vertrouwen op alle niveaus nog ontbreekt, vooral voor de Ethiopische koffies van betere kwaliteit.

Chapter 1

Introduction, objectives, and outline of the thesis

1.1 Background

Agricultural policies can be considered as measures used by governments to influence the social and economic context within which agricultural production takes place (Ellis, 1992). Many developing countries have implemented market reforms, either to satisfy the interests of international donors or to implement measures motivated by the local government. Among these policy reforms, market liberalisation has been critical in developing countries (Krueger *et al*., 1988). However, the outcomes of measures proposed by the neoliberal policies of the donors in the early 1980s and 1990s, summarised as the *Washington Consensus* with its Structural Adjustment Programmes (SAPs), have been disappointing in most developing countries. Enhancing the competitiveness of nations' economies and improving the welfare of the producers, were among the goals envisaged by the SAPs, which they have subsequently failed to achieve (Onis and Senses, 2005). This is as a result of many developing counties' governments attempts to design market policy reforms in their agricultural sectors that seek to improve the stability of prices and marketing margins, and to improve the position of farmers in the market chains (Karanja *et al*., 2003; Gemech and Struthers, 2007; Worako *et al*., 2010).

The Ethiopian coffee industry underwent numerous structural changes as a result of transformations in the country's political and economic landscape. Prior to 1991, coffee markets were highly regulated and coffee producers were faced with implicit and explicit taxation (Worako et al., 2008). Farmers in the primary coffee-growing areas of Ethiopia had to supply a predetermined quota to the government (through the Ethiopian coffee marketing corporation) at a fixed price (Gemech and Struthers, 2007). Following this, a series of policy changes were introduced in 1992. These included a change in the macroeconomic policies of the country, involving stabilisation, adjustment, and market liberalisation programmes. The policies were largely aimed at levelling the playing field for all participants in the coffee market. It was hoped that this would increase the coffee growers' share in the export value as well as the total volume of coffee exported. Ultimately, it was envisaged that this would result in an increase in the total exchange earnings from coffee exports. However, the changes led to a concentration of power within the export market and unhealthy competition in the primary and auction markets (Petit, 2007; Gemech and Struthers, 2007; Worako et al., 2008).

As in many other African countries, not all market liberalisation policies were successful in Ethiopia. Empirical evidence from the Ethiopian grain market illustrated that the removal of policy distortions was necessary but not sufficient to enhance market performance (Gabre-Madhin and

Goggin, 2005). The study suggested that a new development agenda, not only for Ethiopia, but throughout Africa, should aim to move beyond market reform and focus on market development. In addition to policy incentives, key interventions are required to develop appropriate market institutions and build necessary infrastructure (Gabre-Madhin and Goggin, 2005). This is essentially what inspired the Ethiopian Government to reform agricultural markets including the coffee market.

Following a period of reorganisation of the powers and duties of the institutions involved in the Ethiopian coffee sector, the Government decided to abolish the National Auction in 2008 and to harmonise coffee marketing within the Ethiopia Commodity Exchange (ECX) (FDRE Proclamation n. 602/2008, also known as 'the Coffee Quality Control and Marketing Proclamation and its Directives 159/2009 and 161/2009). The ECX was initially established in April 2008 for grains, but after eight months in December 2008, it started trading coffee as well. The idea of trading coffee through a commodity exchange was originally conceptualised in 2003 (Celeste, 2010).

In principle, the ECX aims to improve farmers' access to domestic and export coffee markets. It intends to bring producer prices closer to international levels and reduce the effects of market imperfections. It also seeks to improve the transmission of world and auction market price signals to domestic growers within their respective markets (Worako *et al*., 2008). Ethiopian coffee is produced in different regions throughout the country. These coffees differ in terms of quality and taste, hence, fetching different prices at farm gate, auction, and on international markets (Worako *et al*., 2008).

This doctoral thesis investigates how the ECX has impacted the market integration of coffee producers, traders, and exporters at the international, national, and chain levels. It is assumed that if markets are integrated, the effect of policy interventions and support in one market would be transmitted to other markets. This would reduce the need for duplication of interventions and, thus, reduce the fiscal burden (Baulch, 1997a). Without spatial market integration, price signals will not be transmitted across spatially separated markets (Goodwin and Piggott, 2001; Ghoshray and Ghosh, 2011). Therefore, high levels of spatial market integration could be important for improving market performance. Markets that are not integrated may convey inaccurate price information, leading to misguided policy decisions and a misallocation of resources (Alam, 2012). In Ethiopia, where coffee grows in geographically alienated areas, market-based policies for poverty alleviation of coffee producers and traders

could be more effective if markets were better integrated. It is assumed that better market integration, monitoring and forecasting of price movements, as well as improving marketing infrastructure to enhance market integration (Worako *et al*., 2008), could benefit coffee producers. It is noteworthy to mention that farmers may also benefit in non-integrated markets if protectionist policies were to be implemented properly or if niche markets were established that fetched higher prices.

1.2 Problem statement and motivation of the study

Agriculture remains Ethiopia's key sector, contributing 38.8% of gross domestic product in 2014, with coffee constituting the bulk of Ethiopia's exports (Tefera, 2015). Currently, it is largely understood that agricultural development is vital for developing countries like Ethiopia (Hanmer & Nashold, 2000), which obtain most of their export income from a few agricultural commodities. In an attempt to improve farmers' welfare, the Ethiopian Government made an agricultural market policy reform in 2008 which included the establishment of the ECX to market the major agricultural export commodities. The primary aim of the ECX within the coffee sector is to strengthen the sector's position as one of the main pillars of the economy, and to enable coffee producers to increase their income (Celeste, 2010).

Since world coffee markets between countries exporting Arabica and Robusta coffee are relatively competitive, distortions in one of the major coffee-exporting countries will subsequently be observed in other coffee-exporting nations. While the establishment of ECX aimed to initially address the internal Ethiopian coffee market, it may have impacted the position of Ethiopian coffee on the international coffee market. Hence, it is important to investigate whether the price relationship between the Ethiopian coffee prices and other coffee exporting countries changed with the establishment of the ECX. It can be assumed that Ethiopian exports would not influence international market prices, as volumes are relatively small compared to other exporting countries. Nevertheless, it is of interest to determine whether trading under the ECX has brought about a change in the rate of price transmission from international to national prices.

As previously mentioned, the national auction was abolished as part of the agricultural market policy reforms and was replaced by the ECX, which has warehouses in the major coffee-growing areas of Ethiopia. Prior to the market reform, most of the coffees were transported from the coffee-growing areas of Ethiopia to the central market in Addis Ababa for sorting, inspection,

and grading. Currently, under the ECX, warehouses and information communication systems are transmitting daily coffee prices in an attempt to enhance spatial market integration. Despite trade being strictly prohibited within the Ethiopian coffee market, several studies (Goodwin and Piggott, 2001; Barrett and Li, 2002; Lohano and Mari, 2006) have concluded that this spatial trade and arbitrage could be a primary mechanism for ensuring spatial integration. This would signal the possible gains in transferring excess demand and supply between potential markets. However, the Ethiopian Government's motivation for prohibiting the spatial trade of coffee between different coffee-producing regions was to protect coffee quality and to prevent adulteration between different coffee types.

Market reforms intend to enhance the bargaining power of the coffee producers to enable them to receive a better price and to improve their welfare. The ECX started selling coffee as a commodity, with different varieties being sold in bulk. Coffee marketed through ECX is not traceable to the producer once it leaves the farm gate. Yet, traceability may add value by enhancing product differentiation (Leung, 2014). The traceable coffee chains are managed through cooperatives which could improve the bargaining power of the producers, incentivise production, and reduce transaction costs. Interestingly, these cooperatives imply a level of integration at horizontal level at the same time of vertical market integration (Lazzarini et al. 2001).

This description clearly indicates that the introduction of ECX as a trading platform has had an impact on the different actors in the chain. Firstly, ECX changed the way that coffee is graded for export and how it is sold from traders to exporters. Secondly, ECX implemented a regional warehouse system which changed the way the coffee is traded between the farmers and the traders in the market. Thirdly, the trade of coffee between the regions has been prohibited, meaning that all coffee is sold from the regional warehouses to the central ECX markets. Fourthly, ECX has established several information lines through which price information is transferred between the different actors in the market. And, finally, alternative trade through cooperatives has been allowed, yet its importance remains restricted.

Thus, this study aims to determine the impact of the ECX on price integration between the different actors at the different levels of the chain. It aims to investigates how the ECX has influenced price integration between the Ethiopian markets and international markets, between different coffee-growing areas, and actors throughout the chains across the areas. Furthermore,

it aims to explore how farmers' well-being is affected by marketing through alternative channels to the ECX.

1.3 Research objectives and research questions

This study examines the price integration of Ethiopian coffee markets at farmer, ECX, and export levels in the value chain, as well as how farmers could benefit from integration within traceable export chains that are organised at a cooperative level. The specific objectives are to:

1. Analyse the cointegration of Ethiopian coffee prices with the international markets under quality differentials, before and after the establishment of the ECX.
2. Examine the extent of spatial price integration of major coffee-grower markets in Ethiopia, before and after the establishment of the ECX.
3. Study if the price transmission along the coffee value chain changed within the chains of the different types of Ethiopian coffees.
4. Investigate the welfare impact of de-commoditisation on coffee producers marketing through membership of traceable coffee cooperatives.

1.4 Research questions

In accordance with the research objectives for this study, the following research questions are addressed:

- Did the cointegration of the prices on the Ethiopian coffee market with international coffee prices change after the establishment of the ECX?
- What kind of price behaviour and relationships exist between coffees of different Ethiopian origin in the international coffee market?
- Does restriction of direct trade between coffee-growing regions affect the level of price integration?
- Has the establishment of the ECX created a harmonised cointegration of prices at regional coffee producers' markets?
- Has the price transmission along the coffee value chain changed for the different types of Ethiopian coffees?
- How well do farmers fare if they sell their coffee through certified, traceable cooperatives that are alternative market channels to ECX?

These research questions are answered in four empirical chapters that are at the core of this thesis. These chapters are written as stand-alone papers. Some repetition in the introduction and the structure of the papers may occur.

1.5 Analytical framework

This section presents the analytical framework which guides the different chapters in this thesis. Figure 1.1 illustrates the different impacts that market policy reforms may have on the price integration between the different levels of market actors. We broadly distinguish between producers who sell to either traders in the regional coffee markets, or to certified cooperatives. The traders send coffee to the ECX trading platform where the coffee is sold to exporters. Chapter 2 provides a more detailed account of the Ethiopian coffee market chain, its different actors, and their relationships (Figure 1.1 is a simplified representation). Within its different chapters, this thesis aims to explore the effect of the introduction of the ECX and related policy reforms in the coffee sector on the level of price integration and transmission between the different actors and producers' welfare. The ECX is an important milestone in the reforms of Ethiopian commodity markets. Thus, in the analytical framework, the direct impacts are those measures and changes made in the market as a result of the policy reform. The indirect impacts are the changes that occurred in the market, indirectly due to the policy reform. Therefore, the first three analytical chapters of this thesis will focus on how price relationships between actors have changed with the establishment of the ECX. Further, the fourth and fifth empirical chapters will analyse the effect of the alternative chains to the ECX, namely, sales through certified cooperatives.

Market integration of agricultural products has remained a core issue in developing countries due to its strong relevance in the build-up of the policy framework. Economists often use the term, market integration, explained as the degree of price transmission between vertically or spatially related markets, as a measure of market efficiency (Goletti, Ahmed, and Farid, 1995). Moreover, a government may enhance market integration with policies and strategies that provide infrastructure and information regulatory services that could avoid market exploitation (Dercon, 1995; Baulch, 1997b).

In most cases, producers rely on market price information when making marketing decisions. Poorly integrated markets convey inaccurate price information, subsequent to inefficient arbitrage (Goodwin and Schroeder, 1991). Moreover, the extent of market integration

has important repercussions for the effectiveness of developing agricultural price stabilisation policies (Fackler and Goodwin, 2001).

Systematic paternal movements and relationships between commodity prices arise as effects of shared macroeconomic shocks, and is enhanced by a complementarity or substitutable nature of the commodities (Cashin et al., 1999). Such harmonic price relations could be viewed as outcomes of well-integrated markets, to the benefit of those involved. However, when prices are not integrated, this could also indicate that a commodity is traded in niche markets where better prices are paid. If these better prices are to the benefit of the producers, this could generate positive welfare effects.

The ECX may not (yet) have substantially changed Ethiopia's position in the international coffee market as Ethiopia represents approximately 3.9% of the coffee volume traded in the international coffee market (ICO, 2016). Nevertheless, the ECX framework may have influenced how the prices of the different Ethiopian coffees integrate with the international market. The transparency and quality oriented institutionalisation process of ECX has changed the way exporters interact in the international market. The question whether the ECX has influenced the extent to which the prices of Ethiopian coffees integrate with world market prices is addressed in Chapter 3.

Within Ethiopia, the ECX attempts to have an impact on the levels price integration between regional coffee markets, primarily by improving the transfer of information, trade logistics, and infrastructure. Studies on spatial cointegration consider both spatial trade and arbitrage as mechanisms for ensuring spatial integration, in case there is a continuous information flow between central and regional markets (Goodwin and Piggott, 2001; Ghoshray and Ghosh, 2011). The regional Ethiopian coffee markets are not allowed to trade directly, which has a similar effect to when markets do not trade because of excessive transaction costs. Yet, under the ECX, the different regional coffees are traded at a central market place, which conveys price information to all regional trading centers. Thus, chapter 4 aims to assess whether the establishment of the ECX changed the price relationships between the different regional Ethiopian coffee markets.

Price relationships between market actors could improve significantly if new policies and institutions address market failures. As such, prices would be better transmitted, and markets would integrate across space and time, particularly between international and local markets (Hernandez et al., 2015). However, when price adjustments are not efficiently conveyed to

producers, market intermediaries benefit from imperfections and from reduced market transparency (Le Goulven, 2001). In addition, poor infrastructure and limited communication services increases transfer costs (Rapsomanikis et al., 2003) and affects the transmission of prices. The ECX was introduced in the coffee market to institutionalise the coffee value chain with the ultimate goal of overcoming these marketing challenges, and to increase the efficiency of the market operations. Therefore, chapter 5 investigates the extent to which the price transmission of the different types of Ethiopian coffee has improved along the coffee value chain.

As coffee is mainly produced by small-scale producers, the ECX also aims to improve producer productivity. However, when trading through the commoditisation process of the ECX, much of the traceability of the coffee is lost. Such loss of traceability could have a direct impact on the welfare of the producers. The alternative traceable chain of coffee, namely sales through certified cooperatives, as a form of decommodification is studied in chapter 6. Coffee production could be certified on the production process (organic production) or on the farming system (fair trade).

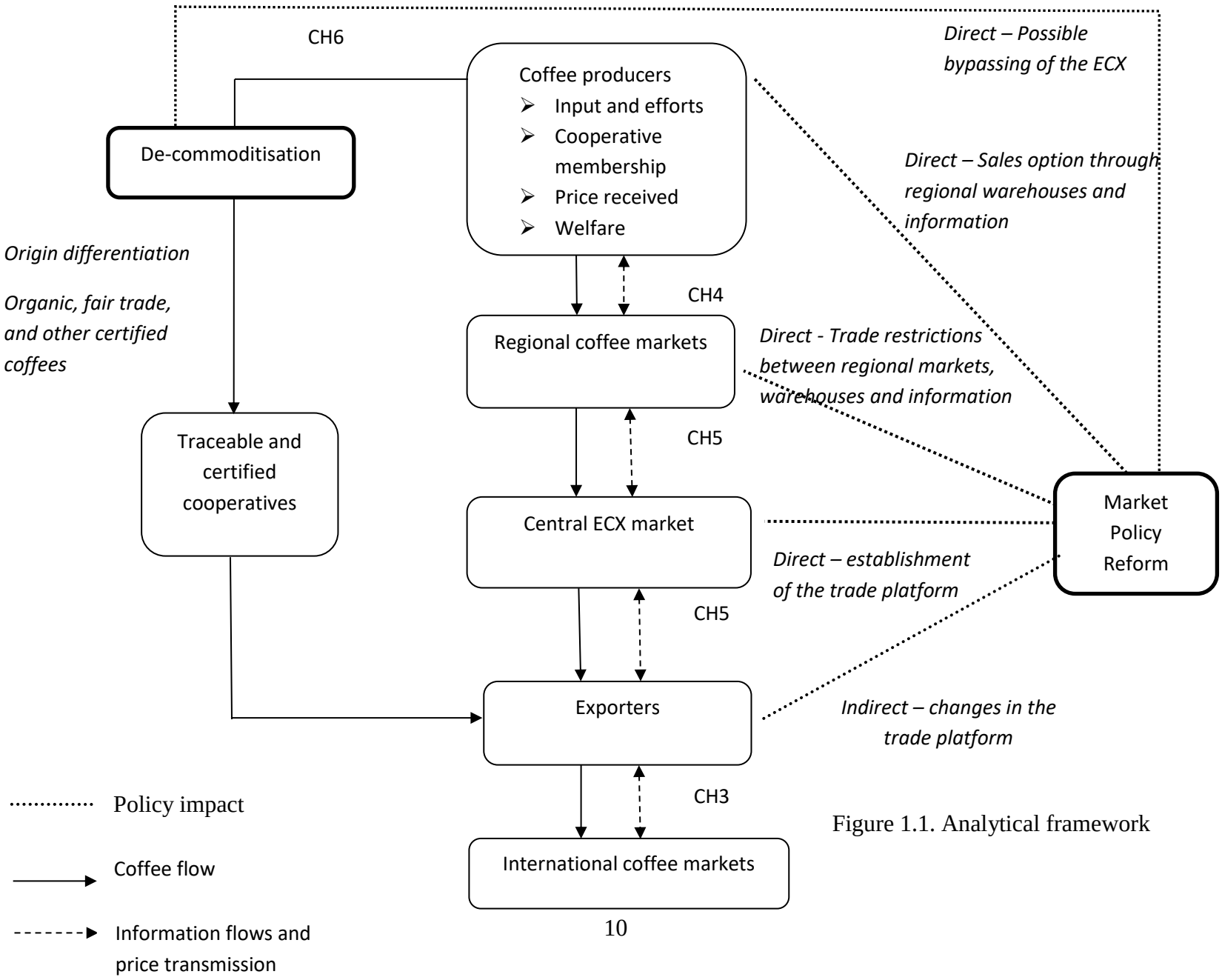


Figure 1.1. Analytical framework

1.6 Data

1.6.1 Price data

Data for this study were collected from different stakeholders and cover the prices for different types of Ethiopian coffee. The producer level price series were collected from the Ethiopian central statistical agency (CSA). Traders' prices at the ECX were collected from the ECX head office in Addis Ababa. The export price for all types of Ethiopian coffee was taken from the Ethiopian revenue office. The price data spans from January 1998 to May 2013 for producers; December 2008 to March 2015 for traders at ECX, and January 1999 to March 2015 for Exporters.

The major coffee-producing areas considered for this study included Kaffa, Wollega, Sidama, Yirgacheffe, Jimma, and Harar. A unique characteristic of the coffees produced in Ethiopia is the vast difference in quality between the different production areas. Despite these quality differences, all the coffees produced in the country are rather homogenous (Worako et al., 2008). As shown in Figure 1.2, many of the coffee-producing areas are located in the southern, south-western and eastern highlands of Ethiopia. In the southern part of Ethiopia, Sidama and Yirgacheffe coffee are the main branded types of coffee. Jimma, Kaffa, and Wollega are located close to each other in the south-western part of Ethiopia. Wollega coffee is said to be superior to Jimma and Kaffa coffee. Harar coffee, produced in the south-east of the country, is reputed to be one of the premium coffees on the world coffee market (Minten et al., 2014). The following chapter will provide a brief description of the characteristics of these different coffee markets.

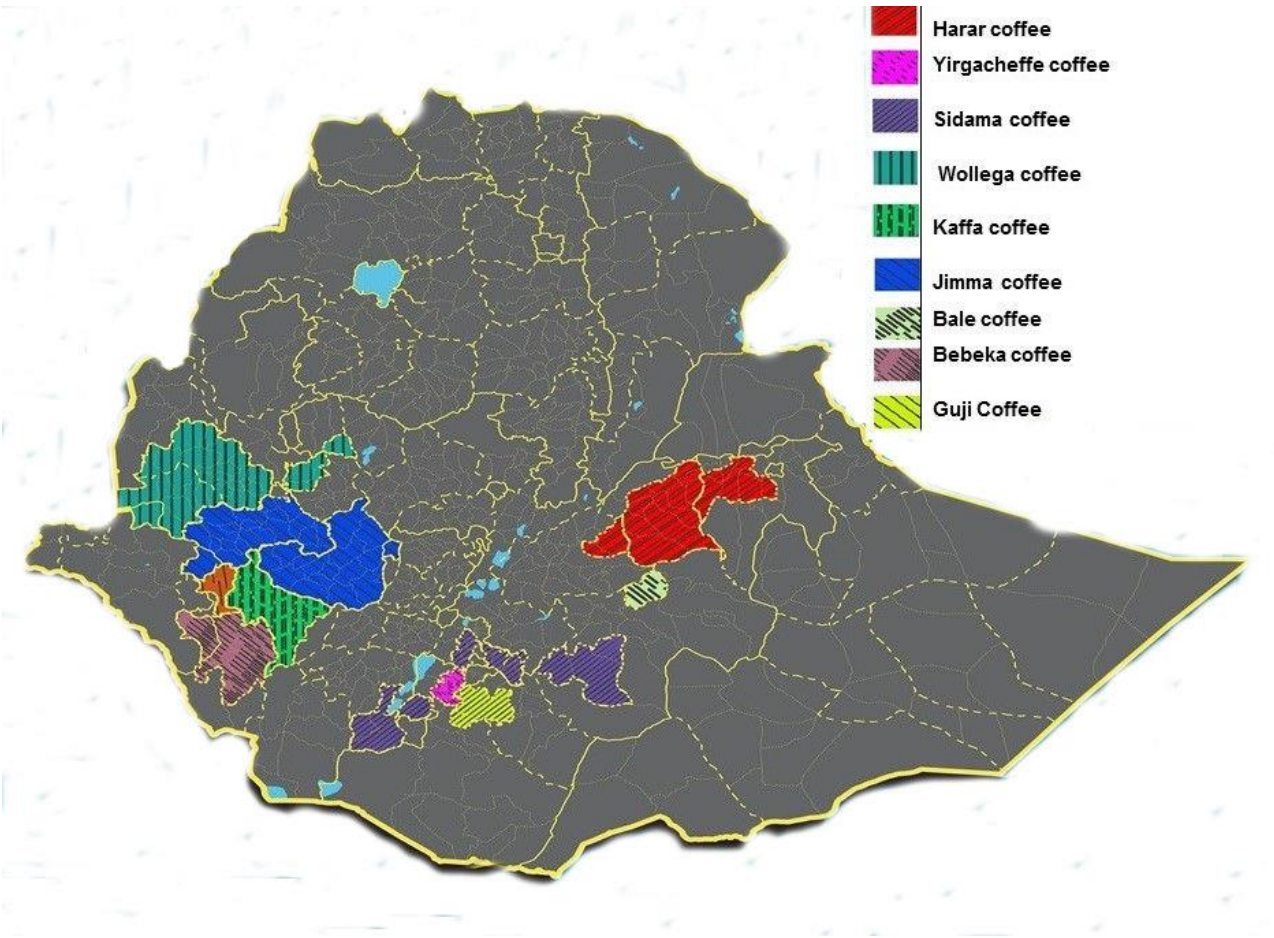


Figure 1.2 Commercial coffee producing areas in Ethiopia

Source: Café imports, 2015

1.6.2 Study area for household level analysis

The analysis of the impact of de-commoditised/ certified coffee presented in chapter 5 uses household data collected in the Jimma and Kaffa zones in south-western Ethiopia. These two zones were selected since they are known coffee production areas with significant potential and a long-standing experience of coffee production. Moreover, these two areas are among the few coffee growing areas that market fully traceable coffee.

The Jimma zone is comprised of 13 woredas[1], with a population of over 2.8 million (CSA, 2014). The elevation ranges from 880m to 3360m above sea level and the zonal agro-ecological setting is stratified as highlands (15%), mid-lands (67%) and lowlands (18%). The zonal rainfall level ranges from 1200mm to 2800mm per annum. In typical years, the rainy season extends

[1] A woreda is a third-level administrative division of Ethiopia.

from February to October. In addition, various other major crops are produced in the Jimma zone, namely maize, teff, sorghum, barley, pulses, root crops, and fruit (Dechassa, 2000).

The Kaffa zone is 10602km^2 in size and lies at approximately 500m to 3500m above sea level. Most of the land is classified as mid-land (59%), in addition to lowland (29%) and highland (11%). The mean annual temperature of the zone ranges from 10.1 to 27.5°C with a mean rainfall of 1001mm to 2200mm per annum. Of the total land, approximately 23.1% is cultivated, 31.5% is forestland, 6% is grazing land, 25% is cultivable land, and the remaining 14.4% of the land is considered to be uncultivable (Chernet, 2008).

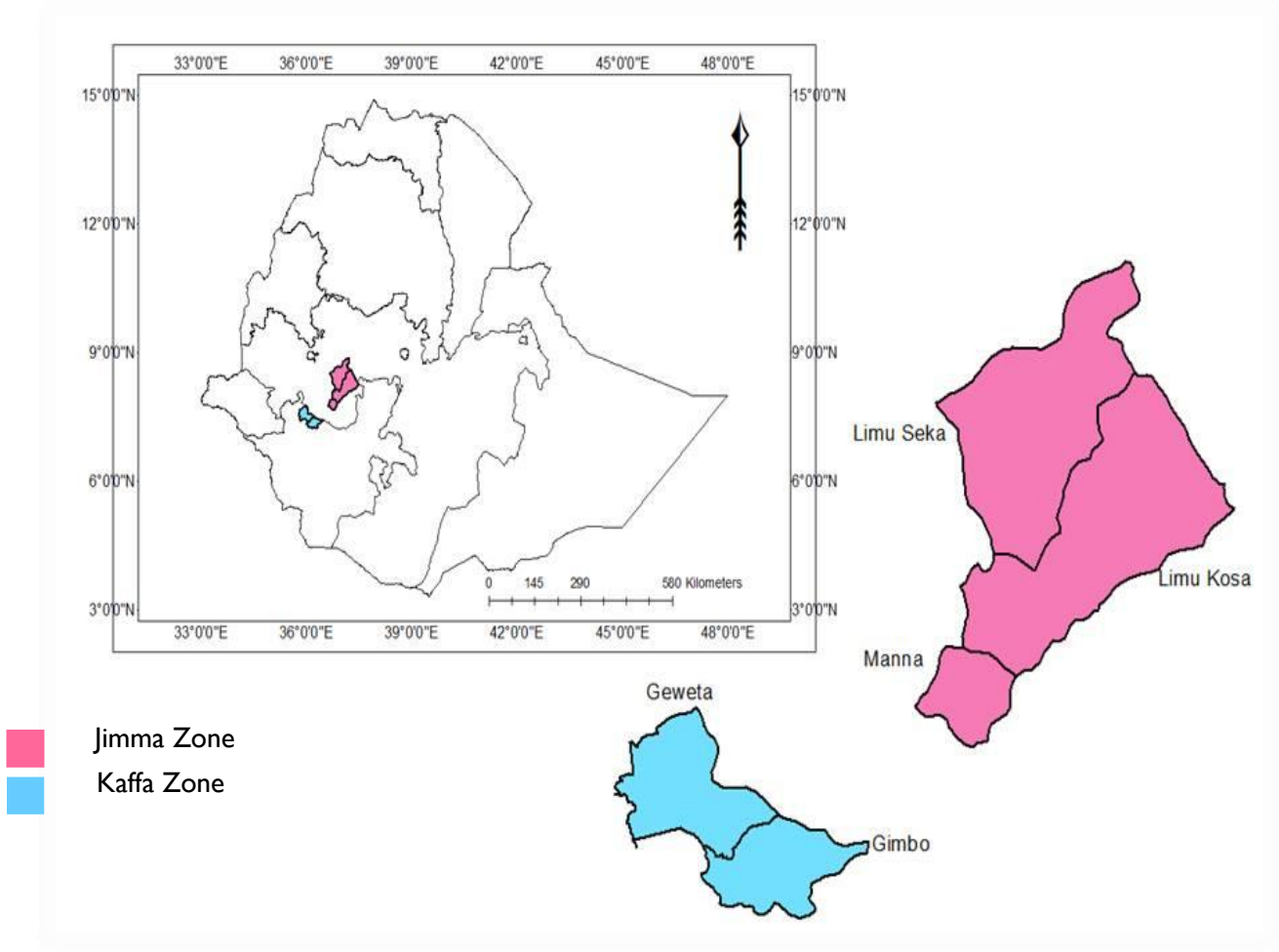


Figure 1.3 Market study area map

Source: Ethiopian Mapping Agency, 2015

1.6.3 Sampling

From the two zones, five certified cooperatives from Kaffa and twenty-two from the Jimma zone, trading under a traceable market, were identified. Using the list of cooperatives from each zone,

these cooperatives were categorised according to their certification system; certified to sell organic, fair trade, organic and fair trade, and forest coffee. Once the certified traceable cooperatives in the two zones had been classified into the different types, they were further classified into small, medium, and large according to the size of their membership. From the identified set of certified cooperatives, a proportional number of cooperatives were randomly selected from each zone (three cooperatives from Kaffa and six from Jimma). Finally, totally, 292 household heads were selected according to the sample size determination table at alpha 0.05 (Bartlett et al., 2001). When selecting members, consideration was given to their affiliation with cooperatives that had consistent sales of a reasonable quantity (30-40%) of their coffee production through the certified and traceable routes over the past two years.

Thus, the current study's sample consists of coffee producers and their families. After minimising possible sampling bias, the study estimated the propensity scores used to match the 292 household members of the certified and traceable cooperatives with 332 households among the comparison groups. Furthermore, we estimated each household's propensity score for joining a certified and traceable cooperative (explained as the probability that a household would participate in a certified and traceable cooperative, given a set of observable characteristics). Household data were collected during the period of October 2012 to February 2013 from the coffee producers in these two zones.

1.7 Methodological approaches

The study made use of different methodologies to answer the aforementioned research questions. The Pesaran et al. (2001) autoregressive distributed lag model (ARDL) and the Shin et al. (2014) nonlinear autoregressive distributed lag model (NARDL) were used to explore the cointegration of Ethiopian export coffee with international coffee prices. Monthly export data from the Ethiopian revenue office, and international coffee prices from the International Coffee Organisation (ICO) for the period 1999-2014 were used for the analysis.

The ARDL model, Toda–Yamamoto granger causality approach, and persistence profile techniques were used to examine the spatial price integration of major coffee growers' markets in Ethiopia between which no direct trade is allowed. Producer market prices from the Ethiopian Central Statistical Agency (CSA) for the major six coffee-growing regions were considered in these models.

To analyse the dynamic relationship between the international and the domestic markets, a nonlinear ARDL cointegration methodology developed by Shin, Yu and Greenwood-Nimmo (2011) was used. This approach allows prices to be more flexible and to establish asymmetric relationships, both in the long and short-run. Price series from December 2008 to May 2013 at producer, December 2008 to March 2015 at ECX, and export levels, collected from the Ethiopian revenue office, CSA, and ECX, were used for the analysis.

The household section of this study adopted an impact analysis approach to investigate the welfare impact of certification and traceability for coffee producers marketing through certified and traceable coffee cooperatives. The study used a propensity score matching procedure to compare traceable cooperative members to non-member coffee farmers.

Table 1.1 Summary of the methodology

Objective	Chapter	Methodology	Methodological advantage
• Extent of integration of Ethiopian coffees in the international coffee market • Estimate the spatial integration of coffee producer markets in Ethiopia	3 and 4	ARDL	• Does not require the order of integration except order 2 prior to testing for cointegration • Provide more consistent results with a small sample size • Different variables can have different optimal lags • Short and the long-run relationships can be estimated simultaneously
• Determine causality in prices among cointegrated markets and explore the direction of causality	4	Toda–Yamamoto granger causality	• Avoids problems related to the non-stationary of the price series while testing for price causality • Employs a Modified Wald procedure to test for restrictions on the parameters of the VAR model
• Estimated reaction time for each of the long-run equilibrium relations to absorb system wide-shocks	4	Persistence profile	• Model the time profile of the response of the cointegrating relation to system-wide shocks
• To analyse the dynamic relationship between the international and the domestic markets,	3 and 5	NARDL	• Extension of the ARDL model • Detect both short and long-run asymmetries between the time series, using positive and negative partial sum decomposition.
• Estimate impact of de-commoditization on coffee producers' welfare	6	PSM	• Match treated and untreated observations on the estimated probability of being treated • Overcomes observed differences between treatment and comparison • It balances treatment and control groups on a large number of covariates without losing a large number of observations
• Evaluate the heterogeneity effect of the de-commoditization	6	SM-HTE and MS-HTE	• Estimate a pattern of treatment heterogeneity effect • Address self-selection bias in impact studies

1.8 Thesis outline

This doctoral thesis is a compilation of individual papers. The thesis is divided into seven chapters, including this introductory chapter, the theoretical briefing of Ethiopian coffee market, four core empirical chapters, and a concluding chapter. Following this chapter, chapter 2 briefly introduces how the Ethiopian coffee market is organised and functions. Chapter 3 presents a comparative analysis of the market integration of the Ethiopian export coffee markets with the international coffee markets in the pre- and post-ECX period. The chapter further examines the

price dynamics of Ethiopian coffee markets in relation to the international coffee market, taking origin (and hence quality) differences as a point of reference.

Chapter 4 discusses the spatial price cointegration of coffee markets in Ethiopia in the pre- and post-ECX period. Here, market conditions are taken into consideration in which government policy restricts arbitrage of coffee trade between coffee-producing areas. Furthermore, the role of coffee quality in establishing market integration is discussed in chapter 4. Chapter 5 investigates market integration and price transmission along the Ethiopian coffee value chain after the establishment of the ECX during the period 2008 to 2013. The chapter serves to analyse whether producer-ECX, producer-exporter, and ECX-exporter price dynamics establish asymmetric relationships, both in the long and short-run.

In addition, the commoditisation process within the ECX has made coffee traceability in the Ethiopian coffee market much more difficult. With the help of donor institutions and cooperative unions, some coffee producers are able to trade through certified cooperatives. Therefore, chapter 6 discusses the impact of certification and traceability in the aftermath of the establishment of the ECX.

Finally, chapter 7 provides an overview of the answers to the different research questions raised, and links the findings to policy implications. This concluding chapter will also suggest recommendations for further studies on the subject.

Chapter 2

Understanding the Ethiopian coffee market

Firstly, this chapter discusses the structure of the Ethiopian coffee market before the introduction of ECX which is pertinent to understanding the following chapters. It introduces the major policy changes that occurred over the course of 30 years. Secondly, this chapter explores the establishment of the ECX in the Ethiopian agricultural market, more specifically in the coffee market. It briefly introduces the rationality for the introduction of the ECX, and the policy changes made to institutionalise the coffee market. Thirdly, this chapter provides an overview of the different varieties of Ethiopian coffee and the process as to how the three Ethiopian coffees secured an international brand name. Finally, this chapter provides an overview of coffee processing and quality inspection services as established by the ECX.

2.1 Coffee market in the pre ECX era

During the military regime that occupied Ethiopia between 1974 and 1991, many private coffee washing stations and large-scale coffee farms were taken over and controlled by the state. Washing stations that were not included in state farms, were owned by the rural service cooperatives, which mainly served the goals set by the government. The cooperatives as well as the state farms had to sell their washed coffee directly through government coffee marketing structures. As a result of these measures, most private coffee exporters became bankrupt, with fewer than 10 who made it through the period (Dempsey, 2006). Moreover, in the same period, producers in the major coffee growing areas of Ethiopia were obliged to sell a predetermined amount of coffee to the government at a fixed price (Gemech and Struthers, 2007).

The new government that overthrew the military regime in 1991 implemented several policy reforms. The corrective measures began with a devaluation of the local currency (Birr) by 142%. By July 1995, the official exchange rate that was used for imports, and the exchange rate that was determined at fortnightly auctions of foreign exchange, conducted by the National Bank of Ethiopia, were aligned. The overall intention of the devaluation and the auction-based exchange rate determination was to enhance the value of coffee exports in local currency and as such to increase producer prices. Thus, a relatively consistent and internally driven programme of commodity market liberalisation was pursued in the 1990s with the consent of the World Bank and the International Monetary Fund (Gemech and Struthers, 2007).

Petit (2007) described the policy reforms that were put in place progressively through the years which consisted of both restraining and encouraging practices. The elimination of the

former state monopoly on trade and marketing, price controls, the quota system for traders, and the export coffee tax favoured these private firms. State control remained firm through the mandatory national auction; the licensing requirements for collectors, suppliers, and exporters; the policy of selling only non-export standard coffee for domestic consumption; and the strict exclusion of multinational corporations to trade as an exporter. In line with this, Hamza and Azenaw (1995) explained that the results of the reforms had a serious impact on the farmers' share in the Free on Board(FOB) price of coffee exports which increased from an average of 42% during the military period to approximately 75% for the period 1992 to 1994.

The Ethiopian domestic coffee marketing system was based on a centrally administered auction system that was stationed in Addis Ababa and Dire Dawa[2] (Figure 2.1) (Petit, 2007). All Ethiopian coffee had to pass through one of the two auction centres. The regulation further requested the physical presence of all coffees at one of the centres. Moreover, depending on the grade it obtained from the Coffee Liquoring Unit (CLU), the coffee was either exported or sold domestically. It was only in 2001 that cooperatives were granted permission to bypass the local traders and coffee auction centres and sell directly to international buyers (Dempsey, 2006). The coffee marketing under cooperatives channel was simple and straightforward. The primary cooperatives purchased either red cherries or dry cherries from their respective members. After processing the cherries (washing or hulling), the primary cooperatives transferred the ownership of the coffee to their cooperative unions (Oromia, Sidama, Yirgacheffe and Kaffa) who had the privilege of directly exporting the coffee to the international buyers (Minten et al., 2014).

[2] The two grading and inspection centres are located in Addis Ababa and Dire Dawa. The Dire Dawa centre used to serve coffee from the Harar and Dire Dawa areas.

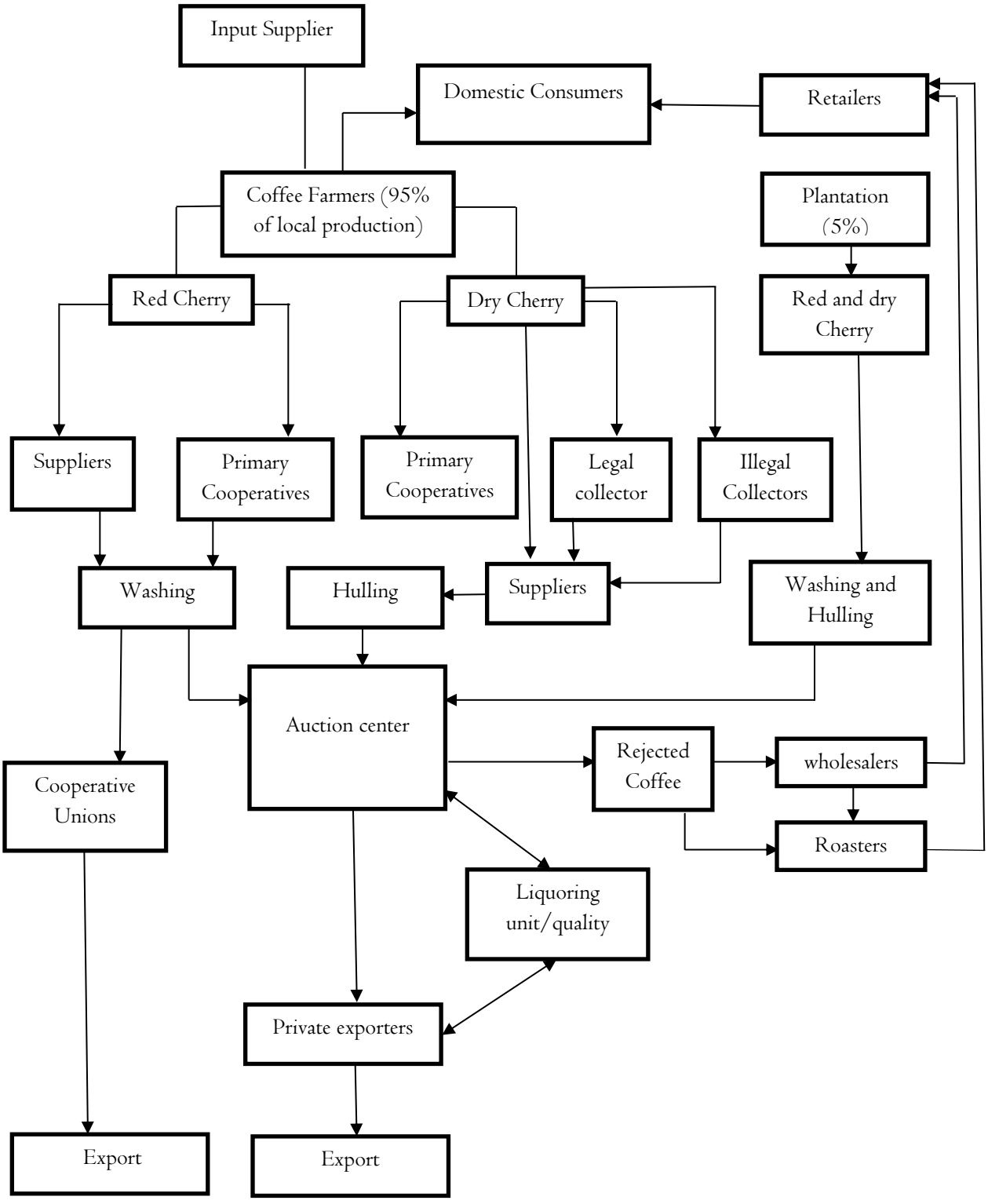


Figure 2.1 Market chain before the ECX

Unlike the cooperative system, coffee traded in the "conventional" channel strictly traded past the auction system. According to Adinew (2011), the local coffee collectors were given the

legal mandate to collect coffee from coffee producers and then sell it to suppliers. However, in some cases it was common practice for suppliers themselves to buy from coffee producers. After washing or hulling, the suppliers transported their coffee beans to the Addis Ababa or Dire Dawa auction centres. Once the coffee had arrived at one of the two auction centres, it was treated in accordance with the origins of the production. The Liquoring Unit performed the grading based on the sample taken from each coffee and displayed the grade to bidders an hour before the auction. The bidding process was performed lot by lot for every sample coffee displayed at the auction centre. The bidding for the export standard coffee was made between suppliers and private exporters.

Furthermore, the coffee that was consumed domestically was settled between the suppliers and the domestic traders. Coffee from both state and commercial plantations were also traded through the conventional channel.

2.2 Coffee market in the post ECX era

The ECX is a commodity exchange that was established with the motivation to revolutionise the traditional Ethiopian agricultural market through a dynamic, efficient, and orderly marketing system. The ECX as a commodity exchange platform is unique as it is the first of its kind in Africa. It has an end-to-end integrated system of central trading, warehousing, product grade certification, clearing, settlement, delivery, and market information dissemination (MoFED, 2009). The exchange in the ECX is structured in a way to distribute market information and link the peripheral regional markets. In an effort to create an integrated market across the country, ECX has established a number of warehouses in production surplus areas (ECX, 2010a). In line with the warehouses, the primary transaction centres that have been established at the regional ECX markets were built to serve as trading platforms for smallholder producers, cooperatives, and suppliers to transact red cherries and sun dried coffee (Adinew, 2011). Within the new market structure of the ECX, the coffee should no longer be physically present in the Addis Abeba or Dire Dawa auction centres. The ECX also aimed to improve the information and communication infrastructure for commodities traded at the exchange. Currently, traders are able to retrieve various types of market information via sms, interactive voice response, internet, radio, television, and newspaper. The electronic tickers installed in the major production areas are another information source for daily commodity price (ECX, 2010a). However, according to a study conducted by Tilahun (2011) on the effectiveness of marketing communication channels

used by the ECX, television, mobile phone, and the radio medium are still the most frequently utilised. Finally, a legal framework for clearing and settling contracts which would guarantee payment and delivery, is built within the ECX (ECX, 2010a).

With the establishment of ECX, the market is currently dominated by private traders, amongst whom the exporters take commanding position amongst the traders. In addition, the close contact with international buyers is believed to favour the exporters. Since the central ECX market is located in Addis Ababa, the exporters stationed themselves in Addis Ababa and installed coffee processing plants that transform the coffee beans brought from regional ECX warehouses into export quality green beans (Celeste, 2010). Furthermore, within the regional markets, many “assemblers/ traders” who were collecting coffee from remote producing areas, have quit the business since the ECX became operational.

Similar to the old auction system, the ECX platform trades coffee at a central market in Addis Ababa, yet the coffee trade is organised differently (Celeste, 2010). Producers are obliged to only sell coffee at rural primary transaction centres. According to the ECX, there are approximately 7300 of such rural primary transaction centres established across the country. After processing (usually at their own processing plants), suppliers have their coffee graded by the regional Coffee and Liquoring Units and stored in the regional ECX warehouses from which they receive a receipt (see below for details on the quality grading systems).

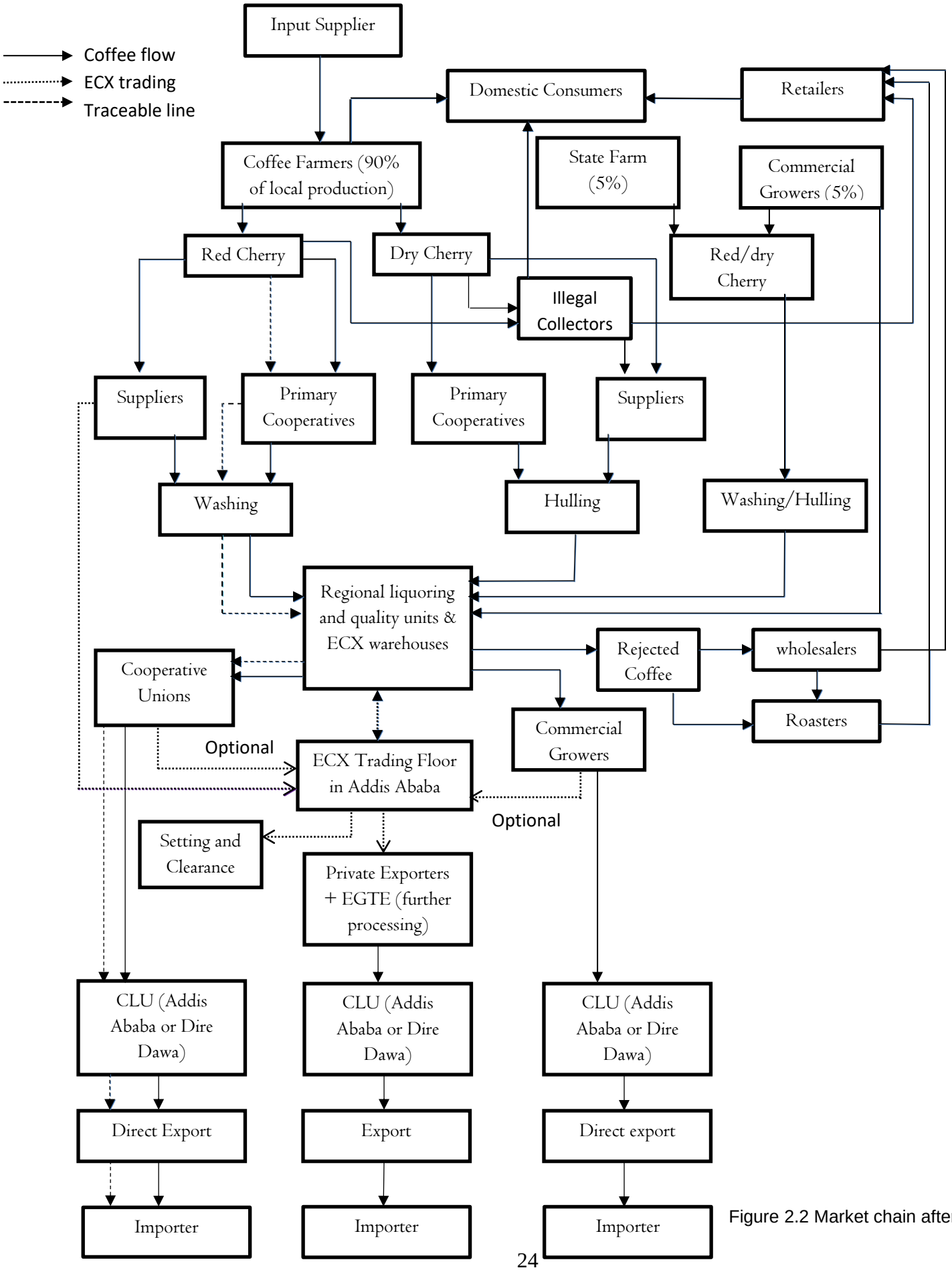


Figure 2.2 Market chain after the ECX

Cooperatives and commercial growers also reserve the right, that was granted by the government, to bypass the ECX and export directly. It is important to note that as the ECX is responsible to monitor all the coffee transactions, both cooperatives and commercial growers are obliged to grade their coffee through the ECX, irrespective of where the coffee is traded.

Initially, the sales of coffee were concluded at the Addis Ababa ECX trading floor through an 'open outcry' system. More recently, an electronic trading platform has been used. In the 'open-cry' bidding, buyers and sellers use their hands to negotiate prices and quantities. Once the deal is settled, they wrap-up through a clash of palms (Niguise, 2011). In 2015, ECX launched an electronic trading system which is more efficient and less costly. Currently, the eTRADE trade volume reached 94% of the coffee transactions. The remaining 6% of trade volume is being handled through the outcry system.

The bidding is made based on electronically transmitted information. This has two main implications: 1) whereas with the old system, the exporting firms relied on the physical presence of the coffee, they now make the bid based on the information (coffee type and its grade) that they get from the regional ECX warehouses; and 2) the transportation costs from the regional ECX warehouses to Addis Ababa (where the coffee will pass through a final processing[3] to meet the export standards) are now incurred by the exporters instead of the suppliers (Celeste, 2010).

Furthermore, all export coffees have a quality certification. This is something that has not changed since the start of the ECX trade in coffee. Wholesalers serving the domestic market and coffee roasters are still required to have a license to operate in the market. Moreover, suppliers who supply coffee to the ECX market have to undergo several competence testes before acquiring the certificate (Adinew, 2011).

Ethiopian coffee is exported and sold as several different types, including Harar, Yirgacheffe, Sidama, Wollega, Jimma, and Kaffa. ECX is structured in a way that prevents spatially separated markets from engaging in direct trade. Keeping the coffee types separate by region is an important strategic choice to preserve the reputation of Ethiopian coffee in the international market and to search for niche markets. The regional ECX coffee markets in the different coffee production areas all have their own marketing infrastructure (including quality

[3] Further processing is done to meet export standards, which is approved by the Coffee Liquoring Unit (CLU). Most of the processing units are located in Addis Ababa

and grading units, warehouses, and notice boards announcing price information). These regional coffee markets are connected with the Addis Ababa ECX market, which is the central market for all the regional markets. This central market disseminates information on the prices that the coffees fetch on the export markets. In this way, ECX pursues an end-to-end integrated marketing system, which integrates central trading, warehousing, product grade certification, clearance, delivery, and market information dissemination which could lead to price adjustments even if there is no direct trade between the markets.

ECX was established with the aim of creating transparency and competitiveness at all levels of the coffee market. Non-value adding actors (for example, assemblers/ local wholesalers) were eliminated from the market with the expectation that it would reduce transaction costs and enhance price transmission. With increasing the number of exporters to 175 in 2012 from 100 in 2008 (Minten et al., 2014), the coffee market was expected to improve the level of competition on the exporter market. While the prices offered in the ECX markets drive the price setting of the producers' market, the ECX does not have the mandate to set export prices. Since the ECX follows the international coffee price for price setting, it most likely influences the price-setting strategy of the exporters. Therefore, the ECX adopted a strategy of selling coffee as commodities in an attempt to reduce transaction costs. Only a few certified cooperatives are permitted to sell coffee, through the unions, for direct export as a way to de-commodify the exports. However, this alternative trade chain accounts for only 3.7% of the Ethiopian coffee exports (ECX, 2008).

2.3 Ethiopian coffee variety, processing and grading

Ethiopia is the motherland of all Arabica coffee. The best Arabica coffee growing countries in the coffee belt have a similar climatic condition to that of Ethiopia. Even before being commercialised, coffee grew in the Ethiopian high mountain and forests. This endowed the country with a rich set of varieties. The most interesting part of the species diversity is that most of these varieties grow only in Ethiopia and yet, a great many of them have not even been classified.

Some of the world's finest coffees are produced in the coffee-producing regions of Ethiopia, boasting unique flavours and aromas. The distinctive characteristics of these coffees differentiate not only the coffee produced in Ethiopia from other coffee-producing counties but

also between the coffees produced within the country. The regional production areas differ in the agro-climatic conditions as well as typical coffee processing techniques which influence the quality of the coffee produced. Harar, Yirgacheffe, and Sidama are the most celebrated types of coffee, each representing a distinct aroma and flavour. In the past decades, international coffee distributors have been using these coffees to market single origin coffees (Mengistie, 2011).

The Ethiopian government, together with some international organisations, took the initiative to protect the intellectual property rights within the Ethiopian production chain. In 2005, the Ethiopian Fine Coffee Trademark Licensing Institute was launched with a mandate to build a framework to secure legal ownership of specialty coffees in international markets (Arslan and Reicher, 2010). Within this legal framework, Ethiopia succeeded in registering trademarks in foreign markets for Harar, Yirgacheffe, and Sidama, and later licensing importers and others involved in the distribution of these coffees for the use of these names. Twenty-nine countries signed the Trademark and Licensing Initiative as of August, 2009 (Belete, 2009 as cited in Arslan and Reicher, 2010). One of the ultimate goals was to de-commodify Ethiopian fine coffees and de-link their price from the conventional international prices for Arabica coffee. However, the path towards the registration of trademarks in some countries was not a smooth one. Nevertheless, the Ethiopian government, in collaboration with Oxfam America, made a concerted effort to secure the agreement (Arslan and Reicher, 2010). Noteworthy is the coffee 'war' between Ethiopia and Starbucks, in which the American coffee chain corporation has influenced the American National Coffee Association's (NCA) rejection of the applications for trademarking the three Ethiopian coffees. However, Starbucks and the Ethiopian government were able to resolve their differences and Starbucks signed the agreement (WIPO, 2009). The following section provides a brief overview of the main Ethiopian coffee types of which the markets are analysed in the subsequent chapters.

HARAR

The climate in Harar is dryer and warmer than the other coffee growing regions of Ethiopia. All coffee produced and exported from Harar undergoes sundried processing. The region is endowed with several local varieties that are specific to the area, that are adapted to the altitude, climate, and soil type to produce unique flavour profiles. Harar coffee is generally grown at altitudes ranging from 1700m to 2000m above sea level. Harar coffee is predominantly grown in the open sun, with infrequent shading observed in a few areas only (Boot, 2011). Moreover,

intercropping is commonly practiced by the farmers. The shade trees observed in the area include Erythrina burana (Korch), Cordia africana (Wanza), Albizia sp (Sesa), and Acacia albida (Girar). Shade trees contribute towards coffee production by creating a favourable microclimate, improving soil fertility, protecting the soil from erosion, and increasing infiltration rate (Amsalu, and Ludi, 2010).

In addition, Harar coffees are appreciated for their fruity characteristic, more specifically their distinct notes of blueberry and a creamy body. In fact, blenders frequently use Harar coffee and Jimma coffee to make a classic Mocha Java. East Harar coffees tend to have the most distinct blueberry flavours, for which the region is famous. In blind cupping tests, West Harar coffees (Bale) outscore East Harar coffees. West Harar coffees generally have a thicker, smoother body, and a milder fruit flavour (Boot, 2011).

Harar coffee is sold as a specialty and commercial type of coffee. The Harar trade brand is internationally recognised. While Harar coffee is exported all over the world, there is a particular demand for it in Saudi Arabia . Trade statistics show that 72% of Saudi Arabia's coffee imports are from Ethiopia (see atlas.media.mit.edu), of which Harar constitutes the largest share. Thus, the high demand for Harar coffee may explain why it fetches higher prices in international markets (Boot, 2011).

SIDAMA

The region of Sidama is one of the major coffee growing areas in southern Ethiopia. Sidama is comprised of ever-green vegetation, fresh water lakes, and the Great Rift Valley that runs through Ethiopia and Kenya. Most of the Sidama coffee features an extraordinarily wide variety of coffee flavours. Generally, the coffee grows at an altitude of above 1500m. Furthermore, coffee is grown under the evergreen shade trees of Milletia ferruginea, Albezzia spp., and Erythrine spp (Tsegaye, 2001). Varying soil types, micro climates, and especially the countless coffee varieties in this area make for a display of different flavours. Thus, there is ample diversity amongst the Sidama coffees. With the notable varietal difference, coffees with completely different coffee profiles are produced in the region. Therefore, it is difficult to literally define Sidama coffee.

Coffee found in the Sidama region is excellently reflected by its deep complexity. Many farmers and pickers, each with a very small patch of land, often with their own unique varieties,

will pool their coffees. High quality, unwashed Sidama coffees are admired for their intense fruity characteristics, while being of somewhat lighter body than unwashed Harar coffees. Sidama coffee also preserves a fruity characteristic when it is subjected to wet processing, which generally produces a clearer and brighter coffee as compared to the unwashed processed coffee.

Sidama coffee is one of the three internationally branded Ethiopian coffees. The main export destinations are Germany (25.54%), Japan (23.1%), the United States (11.42%), Belgium (7.7%), Italy (6.06%), the United Kingdom (5.07%), the Korean Republic (4.04%), Sweden (2.78%), Spain (2.22%), France (1.85%), and Australia (1.11%). The remaining 9% of the coffee is exported to other countries (unpublished raw data). Although it is traded through ECX, Sidama coffees are given three tags: a grade, a geographical letter designation, and designation as washed or unwashed. Finally, specialty grade coffee from Sidama is available as both washed and unwashed types of coffee (Boot, 2011).

YIRGACHEFFE

Despite the smaller size of the region compared to the other coffee producing regions, Yirgacheffe produces one of the premium quality coffees in Ethiopia, of which the price may at times exceed that of Harar coffee. The region shares a similar cultural and geographical environment to the neighbouring area of Sidama. Coffee is produced in the southern highlands at an altitude of over 2000m above sea level. The coffee production system is predominantly a garden crop, intercropped with Enset (Enset ventricosum) or under the evergreen shade trees of Erythrina spp., Milletia ferruginea, and Albezzia spp. (Tefestewold, 1995).

The best Yirgacheffe coffee has several shared characteristics with Sidama coffees. It is known for its fruit flavours, a bright acidity, and a silky mouthfeel. While Yirgacheffe produces both washed and unwashed coffees, its quality reputation is particularly high for the washed coffees. Top quality washed coffees from Yirgacheffe are well known for their bright citrus acidity, often with a lemony character, with excellent sweetness. However, the area has started to attract attention for its unwashed coffees as it has been able to produce some high quality unwashed coffees as well (Boot, 2011).

This is the third internationally branded Ethiopian coffee and the most famous washed Ethiopian coffee. It’s top export destination is the United States, comprising 33.39% of the total

exports. Other major export destinations include Australia (8.53%), Belgium (2.86), Germany (4.65%), Italy (3.22%), the United Kingdom (2.6%), Taiwan (2.14%), China (1.98%) Japan (6.09%), the Korean Republic (13.89%), Saudi Arabia (9.83%), New Zealand (1.66%), and the Netherlands (1.63%). The remaining 7.5% is exported to other countries (unpublished raw data). Similar to Sidama coffee, Yirgacheffe coffees are also given three tags when traded at the ECX: a grade, a geographical letter designation, and designation as washed or unwashed. In addition, specialty grade coffee is available in both washed and unwashed forms.

JIMMA

Jimma coffee is produced in the south-western region of Ethiopia. The area is endowed with various indigenous vegetation which is quite rich in quality diversity. The washed Jimma coffees are known for its heavy bodied cup with a winy aftertaste (Woldemariam, 2015). Jimma coffee grows at an altitude of 1400-2100m above sea level (Adugan et al., 2011). The most important shade tree species found in the area include Albizia spp., Acacia spp., Cordia africana, Milletia spp., Erytherinia spp., Sesbania sesban, and Leucenia lecocephala (Amsalu, and Ludi, 2010).

In the international coffee market, the “Djimma Grade 5” coffee was sold at the lowest price for decades amongst the Arabica coffee. While Jimma is a hub for coffee genetic diversity and has some of Ethiopia’s best farming land, the coffee sector suffers from poor processing practices (Tecnoserve, 2013). The major export destinations of Jimma coffee include Germany (21.82%), France (16.16%), Sudan (14.18%), Belgium (12.99%), Italy (8.83%), the United States (4.95%), Japan (3.87%), Australia (2.89%), Russia (2.66%), Sweden (2.22%), the United Kingdom (2.10%), and other countries (7.8%) (unpublished raw data).

KAFFA

The Kaffa region is believed to be the birth place of coffee. In this region, more than 100 Ethiopian investors have been developing estates and farms growing high quality Arabica coffee. It is blessed with suitable agro-ecological conditions for specialty coffee production. Coffee is produced on altitudes that range between 1600m and 1900m above sea level, and temperatures that are conducive to coffee production (Paulos, 1994). The area is known for high levels of precipitation and this makes it the rainiest region amongst all the coffee growing regions of Ethiopia (Boot, 2011). The region is also the destination for one of the two biosphere reserves

in Ethiopia. Since June 2010, the wild coffee forests in the region have been recognised by UNESCO as a biosphere reserve (Dennis, 2007).

Currently, most farms, estates, and cooperatives are supplying both washed and natural sundried coffees to the international market. A full-bodied Kaffa coffee has delicious chocolate flavours and complex acidity. The major export destinations for Kaffa coffee are Germany (44.9%), Italy (13.76%), the Korean Republic (10.83%), Sweden (10.83%), the United States (8.91%), Australia (5.86%), Canada (3.38%) and other countries (1.5%).

WOLLEGA

Coffee from the Wollega area typically enters the market as “Lekempti", a trade name that originates from western Ethiopian coffees traded through the city of Nekempte. In addition, coffees from East Wollega may be sold as Lekempti. The coffee growing areas of Wollega are found in parts of the highland area in the south-western region of Ethiopia, which receives more rainfall than any other eastern coffee growing areas in Ethiopia. The coffee grows at an altitude of 1700-2200m above sea level. Originally, Wollega is known for its naturally processed beans in western Ethiopia. Furthermore, the coffee is known for its large bean size and the sweet odour from the Wollega coffee is considered extraordinary. Thus, the Wollega coffee reaches high quality scores due to the co-existence of the sweetness, fruit notes, and bright-toned citrus (Boot, 2011).

Washed processing stations have been built with the financial support of donors (including Technoservie) in the region which have led to an increased volume of washed coffee. Wollega coffee is often used by blenders, but is also sold as an original flavour. The major destinations that import Wollega coffee are Saudi Arabia (50%), Germany (26.31%), Japan (12.58%), France (3.01%), the United States (2.22%), Greece (1.8%), the Korean Republic (1.05%), and other countries (2.2%) (see figure 2.3).

2.4 Coffee Processing

Coffee processing involves transforming the coffee cherry into green coffee beans after removing the fruit or pulp. The way in which this is done has a vital impact on the flavour of the resulting coffee (Boot, 2011). A distinction is made between a natural or unwashed processing method and wet (washed) processing methods. Ethiopia produces both washed and unwashed coffee (Boot, 2011). While most of the coffee produced prior to the establishment of the ECX

was unwashed (estimated at approximately 10% of the total production volume), the wet processing gained significance after the establishment of the ECX. Subsequently, its share in volumes processed has gradually increased and currently accounts for 30% of the coffee production (Minten et al., 2014).

For wet coffee processing, the berries should be collected when they are fully ripe, which enables the coffee to retain a proper fragrance and smoothness (Kufa 2012). Once they turn bright red, the berries are picked at intervals of two to three days. This implies that cherry picking is a rather laborious task. Here after, the collected coffee should be taken to and processed at the washing stations within the same day of picking. Failure to do so will affect the ultimate coffee quality.

Furthermore, the coffee cherry passes through several stages before turning into a bean during the wet processing method. Firstly, the harvested cherries pass through a pulping machine where the skin and pulp are separated from the bean. The outer cover of the fruit is washed away discarding the parchment coffee covered in sticky mucilage (Alemu, 2015). Secondly, the beans are fermented in order to break down the sugars within the mucilage and to free the beans from the parchment. The fermentation process usually takes a day, but the local climate, altitude, and other factors could shorten or extend this time (Boot, 2011). Once the fermentation process is finalised, the coffee is discharged into a rinsing tank. Prior to entering the rinsing tank, the coffee passes through a long channel filled with water to wash off any remaining mucilage. Finally, the coffee is taken out of the rinsing tank and dried on a drying bed. It takes one to two days to dry the coffee before it reaches the recommended moisture level (Woldemariam, 2015). The washing stations that are needed for wet processing imply a substantial investment in terms of infrastructure and water consumption. Therefore, water needs to be available in large quantities which raises questions on the sustainability of the wet processing in terms of environmental contamination. Yet, the washed coffee is believed to enhance clarity and aroma.

The ‘old’ processing method involves drying the coffee naturally. This method is still in use today and involves drying the coffee cherries as a whole. Furthermore, this processing technique is frequently used in regions where water is scarce. In Ethiopia, drying is usually done on raised drying beds. The exact number of days needed to dry the coffee will depend on the climatic conditions. During the drying process, the cherries shrink in size and when the moisture content

drops from 65% to approximately 12%, the dry cherries are moved to warehouses where they are stored (Alemu, 2015). In doing so, caution is taken to guarantee the even dryness of the cherries and to avoid the contact of the cherries with the ground. The dry processing method has the advantage of not needing water, hence, this method is common in dryer areas, as well as poorer or more remote areas (Woldemariam, 2015). In general, the longer hours of sun exposure results in the sundried natural coffees having a sweet, fruity character with a creamy mouthfeel (Boot, 2011). The coffee growing areas that are known for their dry processed coffee include Harar, Wollega, Bale, and Jimma.

2.5 Quality and grading

Coffee quality is of critical importance to all the stakeholders in the coffee industry. Quality coffee is frequently related to desirable characteristics such as clean, raw, and roasted appearance, as well as an attractive aroma and good cup taste (Weldesenbet et al., 2008). However, quality and grading have a different impact for the actors at different levels of the coffee chain. Firstly, at the farmer level, coffee quality is linked to production levels and easiness of culture. Secondly, at the exporter or importer level, coffee quality is related to bean size, level of the defects and regularity of delivery, tonnage available, and physical characteristics. Thirdly, at the roaster level, coffee quality is the combination of moisture content, stability of the characteristics, origin of production, price, biochemical compounds, and organoleptic quality (Leroy et al., 2006). Lastly, at the consumer level, price, taste and flavour, effects on health and alertness, geographical origin, environmental and sociological aspects as communicated by certification systems and labels such as organic coffee, rainforest alliance, and fair trade determine the coffee quality (ISO, 2000). Coffee quality is measured in different ways including the visual inspection of the coffee and cup quality. Surprisingly, each producing country has developed its own classification and grade charts. Some of the commonly used criteria include origin, preparation method, bean size, bean shape, colour, number of defects, and cup quality. Cup quality is a complex measure of predicting coffee quality as it depends on several factors. These include genetic factors, botanical variety, agronomical practices, location, processing systems, storage conditions, industrial processing, preparation of the coffee, and consumer preference (Tullu, 2008).

As previously mentioned, prior to 2008, quality inspection and auction sale of coffee was conducted in the two central trading areas, namely Addis Ababa and Dire Dawa. These centres were stationed quiet far away from the major coffee producing areas and had several issues

related to warehousing, sampling, and quality inspection (ECX,2008). During the pre-ECX period, coffee grading was performed using both green coffee analysis and cup quality tests. Furthermore, the Ethiopian Coffee Quality Inspection and Auction Centre was responsible for controlling the quality of export coffee in either Addis Ababa or Dire Dawa, after which the supplied coffee was certified to meet the minimum requirements of national standard for export (ECX, 2008). Even though it was not fully operational, the government had set up coffee liquoring units and quality control mechanisms at regional levels before the coffee was sent to the auction centres. Finally, the coffee that met the quality requirements of the regional quality control bodies was sealed and sent to the coffee quality liquoring and inspection centre (Mengistie, 2011).

Green coffee analysis consisted of the visual inspection of the physical characteristics including size assessment, defect count, colour, and shape of the bean. The assessment through cup quality testing involved the analysis of roasted coffee by which aroma, acidity, and other flavour components were tested. From the overall grading of coffee, green analysis and cup tests accounted for 40% and 60% of the quality inspection process, respectively (Abasanbi, 2010). Moreover, each coffee is scored out of a total of 100.

In the ECX market, coffee is classified according to its origin, class, the preparation type, grade of coffee, and market type (Gabre-Madhin, 2012). In terms of origin, the broader area classification of coffee is taken into consideration. Currently, the market has 22 coffee origins, namely Anderacha, Bale, Bebeka, Bench-Maji, Bi-Product, East Wollega, Forest, Gelana-Abaya, Gimbi, Godere, Harar, Jimma, Kaffa, Kelem Wollega, Kochere, Lekemite, Limmu, Tepi, Sidama, Wenago, Yeki, and Yirgacheffe. Since each of the 22 coffee origins covers a wide range of areas, these coffee origins are grouped by their specific woredas. Each origin coffee has five classes represented by A, B, C, D, and E (ECX, 2015). Coffees are further classified by their processing type as washed or unwashed coffee. Furthermore, coffees are classified by their market type as specialty, export, or local coffee (Boot, 2011). Definitively, specialty coffee is coffee that is distinctive because of its full cup taste and little to no defects, and that it may command a market premium.

For the past seven years, ECX has adopted a 10-level grading and standardisation system. However, since 2015, ECX implemented a new consolidated coffee grading system that reduces the number of coffee grades from 10 to six, for washed and unwashed coffee based on their scores. In other words, Grade 1 = 85-100, Grade 2 = 75-84, Grade 3 = 63-74, Grade 4 = 47-62,

Grade 5 = 31-46, UG (np[4]) = UG[5] (p) = 15-30. Coffees that obtain a grading of 1, 2, in the preliminary assessment undergo a specialty assessment based on cup quality to assess for the potential of specialty coffee. Coffees that receive a Grade 1 (≥ 85.0) or Grade 2 (80.0 - 84.75) score in the cup quality are thus considered as specialty coffees (ECX, 2015). Washed and unwashed coffee of Grades 3 to 5, as well as UG, are labelled as export and local coffee, respectively. In practical terms, it can be put forward that the coffee consumed at the domestic market have higher levels of impurities.

All export standard coffees are further grouped into four categories: commercial washed, commercial unwashed, specialty washed, and specialty unwashed. For example, a coffee might be designated “Yirgacheffe A, Gr. 4” or “Sidama C, Gr. 3”. The first name in the designation (Yirgacheffe or Sidama) indicates the name of the larger region in which the coffee is produced. The letter (A, C) refers to the sub-region that the coffee originates from. For instance, “Sidama C” covers the areas of Kembata & Timbaro, and Wollaita (Tamru and Minten, 2016). This is then followed by the grade (Gr. 4 or Gr. 3).

[4] p and np stand for coffee with and without parchment, respectively.
[5] UG represents under grade (rejected quality coffee).

Chapter 3

Cointegration of Ethiopian export coffee with global markets under origin differentials before and after the establishment of the Ethiopian Commodity Exchange

Abstract

This chapter aims to compare the integration of the Ethiopian export coffee markets with the international coffee markets, both before and after the establishment of the Ethiopian Commodity Exchange (ECX). The study examines price dynamics in the Ethiopian coffee markets in relation to the international coffee market, taking origin and quality differences into account. The empirical analysis applies a Pesaran et al. (2001) autoregressive distributed lag (ARDL)cointegration framework using price data for export coffee from 1998-2008 and 2008-2013, and applying a bounds test approach. For the pre-ECX era, the results indicate that coffees from an origin known for higher and premium quality exhibit higher levels of integration and price adjustment relative to Arabica-type coffees on the international markets. In contrast, the findings from the post-ECX era showed that the highest speed of adjustment towards equilibrium was observed for relatively lower quality Ethiopian coffees. In addition, premium Ethiopian coffee does not seem to cointegrate with any of the Arabica coffees. In both time periods, market distortions in the price of Colombian Milds coffees strongly and directly affected the prices for most of the Ethiopian coffees. Furthermore, we found evidence indicating that relatively lower quality-rated Ethiopian coffees made the greatest price adjustments after price shocks for Brazilian Natural coffee.

Keywords: Coffee price, Coffee quality, Cointegration, Ethiopian Commodity Exchange, Autoregressive Distributed Lag model

Based on: Demise, T., Natanelov, V., D'Haese, M. Cointegration of Ethiopian export coffee with global markets under origin differentials before and after the establishment of the Ethiopian Commodity Exchange.

3.1 Introduction

Agriculture remains key to Ethiopia's economy, contributing approximately 38.8% of gross domestic product (GDP) in 2014/15 (Kibret et al., 2015). Coffee constitutes the bulk of Ethiopia's exports and the sector comprised of 25-30% of the foreign exchange earnings in 2014 (Tefera, 2015). The coffee sub-sector also provides income for a large number of households. It is estimated that of the 91 million people who live in Ethiopia, more than 15 million rely on coffee for a considerable proportion of their income. In addition, the sector provides jobs to many Ethiopian people to carry out coffee-related activities such as coffee processing, transportation, and marketing (ECEA, 2013). Furthermore, Ethiopia produces and exports one of the best highland coffees in the world (see Chapter 2) (Gebreselassie and Ludi, 2008).

A good policy environment is crucial for the coffee sector in Ethiopia (Hanmer and Nashold, 2000). As in other countries, the Ethiopian government has frequently intervened in the coffee sector (as well as in other agricultural sectors). Findings from other developing countries show that the objectives of such market policies were to protect the agricultural sector, which acts as the main source of rural income and of government revenues from foreign exchange (Akiyama et al., 2003; Todaro and Smith, 2006). In the 1970s and 1990s, many developing countries, including Ethiopia, embarked on a liberalisation path induced by the Structural Adjustment Programme (SAP). This path included the restructuring of the agricultural marketing policies (Benedetto et al., 2013). The reforms, which included removal of price controls, trade liberalisation, and privatisation of the government-owned agricultural enterprises, were partly aimed at enhancing trade efficiency (White and Leavy, 2001). The impact of these reforms on the integration of the local markets with international markets and the alignment of local market prices with international prices have been crucial for those countries that rely heavily on foreign income generated through coffee exports. However, as widely documented in the literature, the measures implemented by the SAP during the economic reforms were not all equally conducive to this market integration (Dercon, 1995; Ismet et al., 1998).

Despite the fact that Ethiopia has been through a number of structural market changes, the performance of the coffee sub-sector has remained unsatisfactory. Therefore, recent attempts have been made to enhance the productivity and competitiveness of the Ethiopian coffee sector. One such attempt, in 2008, involved replacing the national auction by the Ethiopia Commodity Exchange (ECX) (See Chapter 2). This new institution was established as an

organised marketplace, where buyers and sellers could come together to trade[6], be assured of quality, quantity, payment, and delivery, with the aim of organising efficient and transparent market operations (ECX, 2008). The initiators of the ECX model suggested that key interventions were needed to develop appropriate market institutions and to build the necessary infrastructure (Minten et al., 2014).

Prior to the establishment of the ECX, the coffee sector was constrained at all levels of the value chain. For instance, a highly-centralised coffee market was located far away from the major production areas. Coffee quality inspection centres were centralised and inefficient, resulting in frequent and significant adulteration of the coffees. Suppliers manipulated trading activities by relying on the inconsistent sampling techniques used at the quality inspection centre. Furthermore, the relatively high transaction costs for trading, lack of an adequate international standard quality supply, inconsistency in coffee quality, and a lack of understanding of international market demands were among the major challenges that the coffee sector was facing in the export arena (ECX, 2008). The ECX was intended to overcome many of these challenges and to stimulate the production of quality coffee.

However, a particular concern is whether the ECX has been successful in achieving a better cointegration of Ethiopian coffee prices with those on the world market. This relates to the question as to whether different Ethiopian coffee prices evolve, come together, or react strongly to changes in the international coffee prices and show similar effects when confronted with external shocks. If a single market for coffee were to exist, this would imply that a price change in a certain coffee quality range would result in similar changes in the prices of the other coffees. When different coffees are traded in the same market, all prices should cointegrate in pairs, since any two prices show uniformity when they share a common trend (Asche et al., 1999). In addition, if all prices cointegrate in pairs, a single common stochastic trend exists (Stock and Watson, 1996). Yet, prices may also deviate if coffee is traded in niche markets.

Since world coffee markets are quite competitive and relatively free from trade restrictions, price or market distortions in any of the major coffee exporting countries are observed in the other coffee exporting nations as well. For example, Brazilian coffee production decreased in 2014 due to bad weather, which resulted in a price spike in the international coffee market (ICO, 2014a). Furthermore, it is widely believed that there is intense competition between

[6] Exchange under the ECX is currently only performing a spot contract, however, attempts are being made to launch trading in the near future.

countries exporting Arabica and Robusta coffees, as well as between Arabica coffee-exporting countries in the international market.

The Ethiopian Arabica coffees are labelled by their place of production or origin. Harar, Yirgacheffe, Sidama, Jimma, and Wollega are the major denominations of origin. Apart from the difference in place of production, these coffees exhibit quality variations. Of all the coffee origins, Harar and Yirgacheffe coffees are perceived to be premium coffee types, while Jimma coffee is considered to be a relatively lower quality of coffee. Quality and origin have become increasingly important in the coffee market, which is shifting from a quantity-oriented agricultural market to a consumer-driven market. Hence, origin and quality differences could drive the price relationships and their adjustments to changes in local or international prices.

For this study, we were particularly interested in the dynamic price relationships between Ethiopian export coffee prices and global coffee prices. The present study takes the establishment of the ECX as a turning point and aims to investigate the cointegration of Ethiopian coffee prices[7] with prices in the other coffee-exporting countries for the periods 1999-2008 (pre-ECX) and 2008-2015 (post-ECX). Therefore, prices on the international market for the following coffee types are considered: *Colombian Milds* (Colombian), *Other Milds* (Costa Rica, Guatemala, Honduras, Mexico), *Brazilian Natural* (Brazil), and *Robustas* (Indonesia, Uganda, Vietnam). The price behaviour and relationships between the Ethiopian export coffee prices and the international market prices were examined before and after the establishment of the ECX in an attempt to explore its influence. Studying the effects of market policies, as measured by their impact on cointegration, was also proposed by Kilima (2006), who argued that the success of market reforms partly depends on how strongly domestic market prices are related to international market prices.

The purpose of comparing the integration of the different types of Ethiopian coffee with international coffee is not to measure the level of competitiveness of the Ethiopian coffees in the international market, nor is it to compare their markets to those of other quality coffees. Rather, it aims to examine the impact that the ECX has exerted on the extent of price integration of the Ethiopian coffee prices with international coffee market prices. In addition, a comparison is made with the prices of Robusta coffee. While Ethiopian coffees are Arabicas, we also explore their price integration with Robusta coffees since both coffee types may be used in blends.

[7] For this chapter, Kaffa coffee has been dropped as it does not feature among the internationally known types of Ethiopian coffee.

The following section provides a literature review of cointegration which is followed by a description of the methodological approach used in this study. Subsequently, the results and discussions are presented after the methodological section. Finally, conclusions are drawn in the last section of this chapter.

3.2 Background

Most commodity prices rise and fall in harmony. Systematic paternal movements and relationships between commodity prices arise as effects of shared macroeconomic shocks, or due to the complementarity or substitutable nature of the commodities (Cashin et al., 1999). Several studies have used time series analysis to investigate price relationships between various spot prices for coffee. A study conducted by Ghoshray (2009), explored the impact of coffee quality on the dynamics of coffee prices. The present study examined the price relationships for different qualities of coffee and how prices adjust over time in relation to each other. It confirmed that the coffee market is highly integrated and that prices adjust to any deviation, either increasing or decreasing. Furthermore, a rise in the price of a high-quality coffee resulted in an increase, however slow, in the price of a relatively lower quality coffee, while a decrease in price for higher quality coffees triggered a relatively rapid fall in the price of lower quality coffees.

Similarly, Milas et al. (2004) examined the price relationships between the different types of coffees on the international market (Unwashed Arabicas, Colombian Milds Arabicas, Other Milds Arabicas, and Robusta coffee). Their study found two cointegrating relationships in the short-run dynamics of the four coffee prices. Moreover, the estimates of the asymmetric and polynomial error correction models provided evidence indicating that when the coffee prices are relatively high, they returned to equilibrium slower than when prices were relatively low. The study also showed that price adjustments are quicker when deviations from the equilibrium level increase.

A further study by Fry et al. (2011), explored the causality and effects of external shocks (adverse harvests and changes in future contract specifications) on the interaction between spot and future markets. The results of the study found a bi-directional causal relationship between spot and future markets. However, the way in which spot and future markets interacted was not static and changed over time in response to exogenous shocks. The study also presented

evidence of higher price volatility on spot markets. This volatility may be due to climatic effects which influences the supply on the world market. This was further investigated by Ubilava (2012) who studied the impact of the El Nino Southern Oscillation (ENSO) on world coffee price dynamics for the four major coffee types. Results suggested that ENSO did have an impact on coffee prices. As the production of the different coffee varieties is geographically clustered, a positive ENSO shock had a positive effect on the price of Robusta, but a negative effect on the price of Arabica coffee.

While the above account is merely a snapshot taken from all the studies on coffee price cointegration, it shows that coffee prices on different markets cointegrate, but that the level and speed of price adjustments depends on factors determined by coffee type and on the importance of exogenous shocks. However, the Ethiopian export coffee market has been largely under-researched and under-represented in the literature. This is surprising since the Ethiopian case is particularly interesting from a research point of view. On the one hand, coffee production is crucial for the economy and for the livelihoods of many smallholder coffee farmers. On the other hand, the local coffee market, and hence the income that these smallholder farmers receive, has changed since the establishment of the ECX. Thus, this study contributes towards the field of agricultural literature in two ways. Firstly, the present study investigates how the prices of different Ethiopian origin coffees integrate within the global coffee market. Previous studies investigating export coffee price integration have considered quality differences between the exporting countries (Milas et al., 2004, Ghoshray, 2009). However, this study takes the price of Ethiopian coffees with different origins into consideration. Secondly, as far as we understand, no other study has been previously conducted on the changes in the cointegration of the Ethiopian coffee market with the international coffee market since the establishment of the ECX.

3.3 Data sources and econometric methods

3.3.1 Data and sources

The data used for the present study consists of average monthly Free on Board (FOB) coffee price series for Ethiopian and major coffee types in the international market, for the period between January 1999 and March 2015. The major Ethiopian coffees considered for this study are Sidama, Yirgacheffe, Jimma, and Harar, whereas Brazilian Naturals, Colombian Milds, Other Milds, and Robusta are considered for the global coffee market. The Ethiopian export prices were obtained from the Ethiopian Revenue and Customs Authority's unpublished annual price

report, while coffee prices on the international market were obtained from the International Coffee Organisation (www.ico.org). All Ethiopian coffee prices wet converted into US dollar/kg[8]. Furthermore, all prices were indexed based on the price in January 1999 for each type of coffee in order to overcome problems of comparing distant price data. The observations from January 1999 to November 2008 were considered pre-ECX, while the post-ECX subseries ran from December 2008 to March 2015.

Figures 3.1 to 3.4 present the price evolutions between Ethiopian and international coffee prices. The figures suggest that most of the Ethiopian coffees have a close relationship with international coffee prices. The global coffee price boom in 2011 and 2012 was also observed in the Ethiopian coffee prices. Moreover, Ethiopian coffee prices were characterised by frequent short price spikes. In early 2012, the international coffee prices, including Ethiopian coffee prices, started to decline. However, the price of Harar coffee only started to decrease in 2013.

Columbian Milds, which are considered to be the highest quality coffee, command a premium on the world market. Other Milds coffees and Brazilian Naturals are considered intermediate to low-quality Arabica coffee (see ICO, 2014a), and the price differences between Other Milds and Brazilian Naturals is small (see ICO, 2014b). The Robusta coffee group is considered as inferior quality, which is also reflected in its lower price compared to the price of other coffees. Although, the international demand for Robusta coffee has increased during the last decade (ICO, 2014c).

Ethiopian coffees are in high demand on the world market. This is due to the country's favourable environmental conditions, such as suitable altitude, ample rainfall, optimum temperatures, appropriate planting materials, and fertile soil. Ethiopian coffee is known for its unique aroma and flavour. Ethiopia also has a broad genetic diversity amongst its coffee varieties, including the indigenous variety of Arabica coffee (ECX, 2008).

[8] Prices were converted to USD/kg for the tables and figures for easier interpretation by the reader.

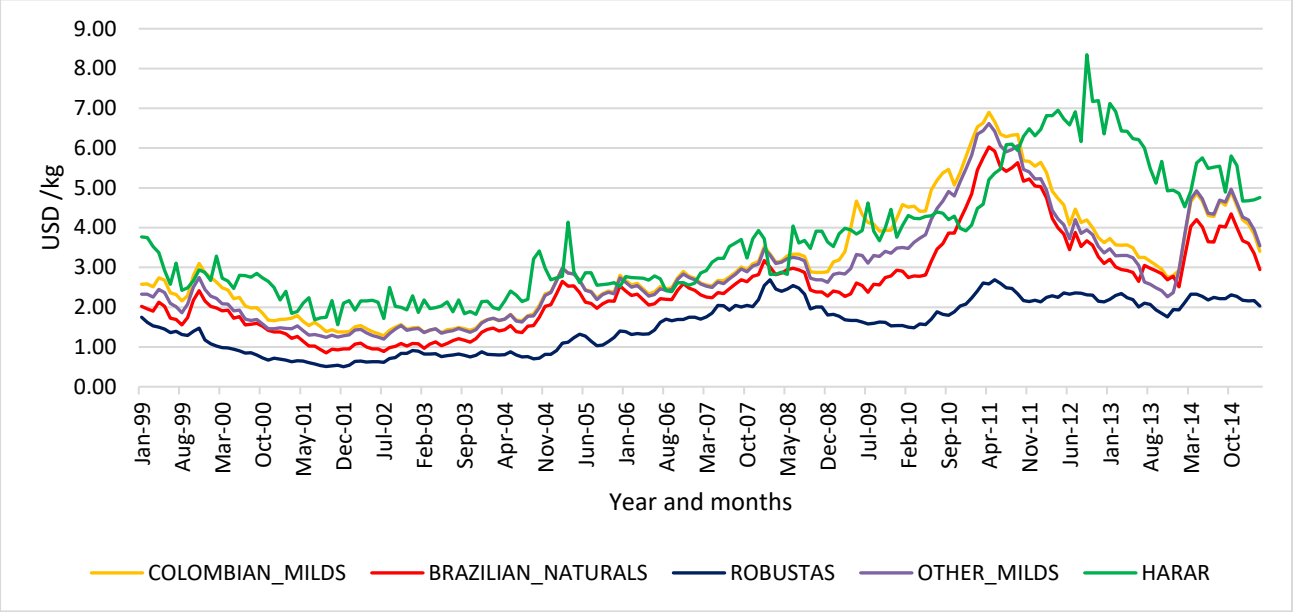


Figure 3.1 Comparison of the price of Harar coffee to the international prices (1999 to 2014) (USD/kg)

Source: ICO

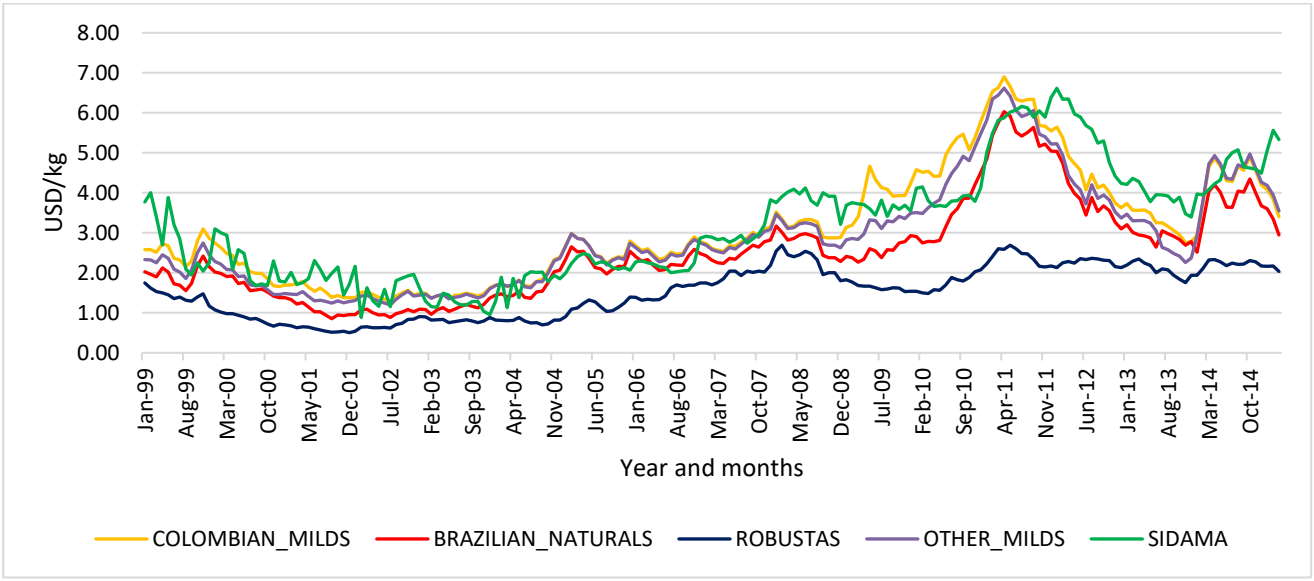


Figure 3.2 Comparison of the price of Sidama coffee to the international prices (1999 to 2014) (USD/kg)

Source: ICO

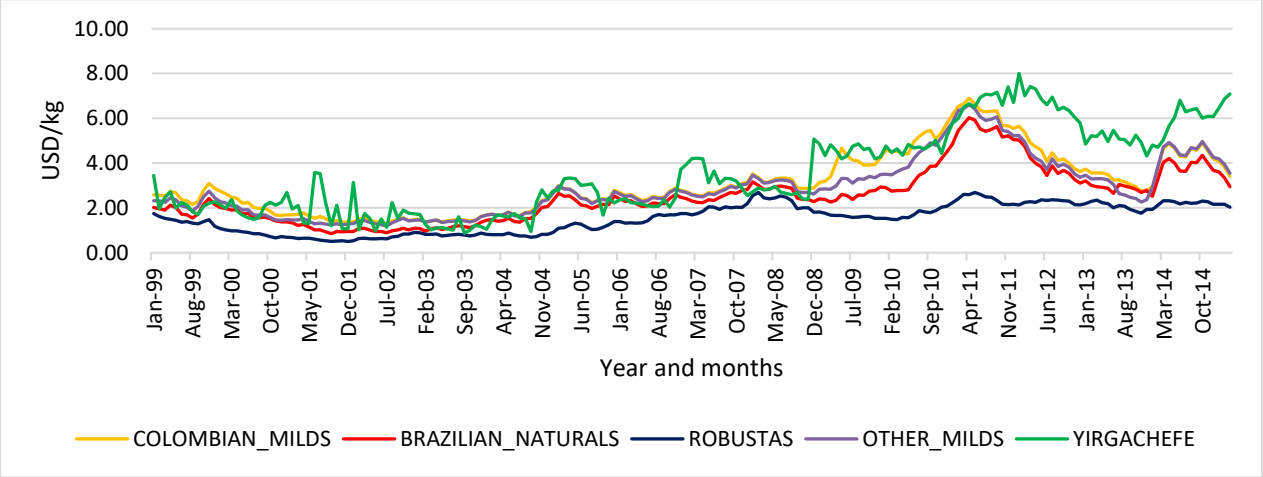


Figure 3.3 Comparison of the price of Yirgacheffe coffee to the international prices (1999 to 2014) (USD/kg)

Source: ICO

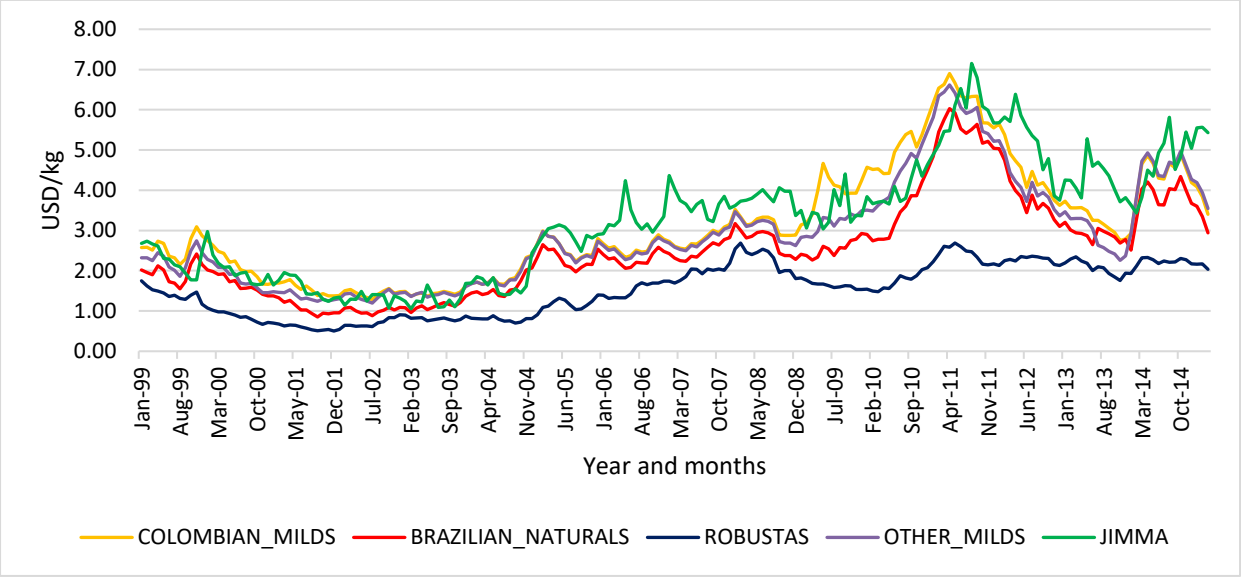


Figure 3.4 Comparison of the price of Jimma coffee to the international prices (1999 to 2014) (USD/kg)

Source: ICO

3.4 Econometrics methodology

To investigate the stationarity issue (the possible presence of unit roots in the price series), the study performed a univariate analysis of each of the price series. Furthermore, the existence of cointegration between the price series was tested using an Autoregressive Distributed Lag (ARDL) model. This model has a number of advantages over the other linear cointegration

models. We also introduced a Nonlinear Autoregressive Distributed Lag model (NARDL). This model allows for the investigation of short- and long-run asymmetries between time series.

3.4.1 Stationarity test

Since most macroeconomic time series seem to be non-stationary, most of the cointegration techniques require testing the stationarity of the individual variables (Nelson and Plosser, 1982). Stationarity tests are a necessary pre-condition, since modelling with non-stationary variables can result in spurious relationships. In some time-series analysis, a combination of non-stationary variables may result in cointegration, while they are actually not cointegrating. In such cases, the standard assumptions for asymptotic analysis are not valid and the usual t-ratios will not follow a t-distribution (Nielsen, 2005). In cases where the time-series are non-stationary, alternative modelling approaches need to be considered.

The Augmented Dickey–Fuller (ADF) test is frequently used to test stationarity. It tests the null hypothesis that a series (X_t) is non-stationary by calculating t-statistics for $\omega = 0$. Based on Dickey and Fuller (1981), the formula is written as follows:

$$\Delta Xt = \lambda + \omega Xt - 1 + \alpha t + \sum_{j=2}^{m} \beta_j \Delta X_{t-j} + \varepsilon_t \qquad \text{Eq. 1}$$

Where $\Delta X_t = X_t - X_{t-1}$, $\Delta X_{t-j} = X_{t-j} - X_{t-j-1}$ and j= 2,..n, and where X_t, X_{t-1}, X_{t-j} and X_{t-j-1} are the prices at time t, t-1, t-j and t-j-1 respectively. Whereas, λ, ω, α, and β are the parameters to be estimated and ε_t is the white noise error term. If the value of the ADF statistics is less than the critical value, the price series (X_t) are said to be stationary. If X_t is found to be non-stationary, it needs to be determined if X_t is stationary at the first difference. If the first difference of the series (ΔX_t) is stationary, the price series (X_t) is considered to be integrated to the order of one. The lag length calculated for each of the price series considers that the residuals possess a white noise character.

3.4.2 The bounds test approach to cointegration (ARDL model)

We used a bound testing approach to cointegration in an ARDL framework developed by Pesaran et al. (2001). This model has various interesting characteristics compared to other approaches for testing cointegration. Firstly, the ARDL procedure can be applied when the regressors are I(1) or I(0), except for the order of integration two (I(2)) (e.g. see Wolde-Rufael, 2005 and Emran et al., 2007). This means that the ARDL procedure does not require any

knowledge of the order of integration and thus avoids the inherent limitations involved in testing for unit roots prior to testing for cointegration. Secondly, the ARDL procedure is a statistically significant approach for determining cointegration relationships in studies with a small sample size (Narayan, 2005). Thirdly, the different variables can have different optimal lags when using the ARDL procedure. A fourth advantage is that the ARDL procedure employs a single reduced form equation, while the conventional cointegration procedures estimate the long-run relationships with system equations. Finally, the approach is based on the estimation of a dynamic error correction model and tests if the lagged levels of the variables are statistically significant. In addition, the short- and the long-run relationships can be estimated simultaneously (Emran et al., 2007). Regardless of the above-mentioned advantages, ARDL results can be inconclusive in certain instances.

For example, as proposed by Pesaran et al. (2001), the standard ARDL (g, q) cointegration model can take the following form:

$$\Delta P_{nt} = \beta 0 + \sum_{i=1}^{g-1} \omega_{1i} \Delta P n_{t-i} + \sum_{i=0}^{q-1} \omega_{2i} \Delta P m_{t-i} + \omega_3 P n_{t-1} + \omega_4 P m_{t-1} + \lambda_{lt} \qquad \text{Eq. 2}$$

where P_n is the coffee price in market n and $\mathrm{P_m}$ is the coffee price in market m. The parameters $\omega_{1\mathrm{i}}$ and $\omega_{2\mathrm{i}}$ with $i = 1, 2$ are the corresponding long-run multipliers, while the parameters ω_3 and ω_4 are the short-run dynamic coefficients of the underlying ARDL model. The first step in the ARDL bound approach is to estimate the equation using ordinary least squares. With Eq.2, the model tests the joint significance of the lagged price levels in markets n and m. Under the null hypothesis, no cointegration is defined as H0: $\omega_3 = \omega_4 = 0$ against the alternative hypothesis H1: $\omega_3 \neq \omega_4 \neq 0$.

The basis for the ARDL bound test is the Wald-test or F-statistics. Two sets of critical values, a lower critical bound and an upper critical bound, for the cointegration test were first developed by Pesaran et al. (2001), and later modified by Narayan (2005) in order to accommodate small sample sizes. A lower critical bound is used when all the variables are I(0) or when the variables are not cointegrated. The upper bound assumes that all the variables are I(1) and are cointegrated. F-statistics larger than the upper critical bound suggests to reject the hypothesis that markets are not cointegrated irrespective of the series being I(0) or I(1). When the F-statistics are lower than the lower critical bound, the hypothesis of no cointegration cannot

be rejected. However, when the F-statistics calculated fall between the two critical values, the result is inconclusive (Pesaran et al., 2001).

If a cointegration relationship is established between P_n and $\mathrm{P_m}$(Eq. 2), the next step would be to estimate the ARDL model with the optimal lag. To determine the optimal lags for each price series, the ARDL method estimates $(\mathrm{R}+1)^{\mathrm{a}}$ number of regressions, where R+1 is the maximum lag to be used and superscript a represents the number of variables in the equation (Shrestha and Chowdhury, 2005; Li and Lin, 2015). According to Pesaran et al. (2001), the optimisation process is performed using the Akaike information criterion(AIC):

$$\Omega(L, R_0)Pn = \mathcal{B}_0 + \mathrm{C}(L, S_1)Pm + \mho_t \qquad \text{Eq. 3}$$

where

$$\Omega(L, R_0) = 1 - \Omega_1 L - \Omega_2 L^2 - \ \ldots\ldots\ldots\ldots - \Omega_{R_0} L^{R_0}$$

$$\mathrm{C}(L, S_1) = \mathrm{C}_0 + \mathrm{C}_1 L + \mathrm{C}_2 L^2 + \ \ldots\ldots\ldots\ldots + \mathrm{C}_{S_1} L^{S_1}$$

L denotes the lag operator with $L^i Pm = Pm_{t-i}$, i = 0, + 1, + 2, etc. In the long run, we have $Pn_t = Pn_{t-1} = \ldots = Pn_{t-R0}$; $Pm_t = Pm_{t-l} = Pm_{t-S1}$.

Furthermore, equation 4 estimates the long-run equation as follows:

$$Pn = \gamma + \mathrm{C}Pm + \mathcal{E}_t \qquad \text{Eq. 4}$$

Where $\gamma = {}^{\mathcal{B}_0}/_{\Omega(1, R_0)}$

$$\mathrm{C} = \mathrm{C}(1, S_1)/\Omega(1, R_0);$$

$$\mathcal{E}_t = \mho_t/\Omega(1, R_0)$$

C in equation 4 represents the long-run coefficient which explains the degree of market integration. If two markets establish a long-run integration, C explains the extent to which a price change (increase or decrease) in one of the markets is a result of a price change in the other market. However, the long-run cointegration coefficient does not indicate which variable induced the integration. If we were to discover evidence of long-run relationships between coffee price series, then we could estimate the short-run coefficients according to the following model:

$$\Delta Pn_t = \gamma + \sum_{i=1}^{R_0-1} \mathrm{C}_{R_0} \Delta Pn_{t-i} + \sum_{i=0}^{S_1-1} \mathrm{C}_{Si} \Delta Pm_{t-i} + \mathrm{C}_e ecm_{-1} + \mu_t \quad \text{Eq. 5}$$

where $ecm_{\mathrm{t}} = \mathrm{Pn_t} - \gamma - \mathrm{CPm_t}$. In the error-correction term model, the residuals obtained from the estimated cointegration model of Eq.2 are incorporated in the estimation of Eq. 5. The model explains the speed of adjustment needed to restore long-run equilibrium following a short-run shock. Moreover, the value of the error-correction term should be negative and statistically significant.

For the robustness of the ARDL model, it is necessary to perform a diagnosis test. The Breusch-Godfrey Lagrange Multiplier test for serial correlation and the Autoregressive Conditional Heteroscedasticity (ARCH) test (Engle, 1982) for heteroscedasity are the two most commonly used tools. These tests are performed on the residuals of the estimated variables.

3.4.3 Nonlinear Autoregressive Distributed Lag model (NARDL)

Many recent studies on cointegration have considerd the existence of nonlinear relationships between different macroeconomic variables (Atil et al., 2014; Jammazi et al., 2015; Fousekis et al., 2016). Since we were particularly interested in price adjustments, we also estimated an extension of the ARDL model, as recently developed by Shin et al. (2014), that accommodates asymmetric price dynamics. The novelty of this technique is its ability to detect both short- and long-run asymmetries between the time series, using positive and negative partial sum decomposition. The asymmetric ARDL[9] specification allows for the analysis of non-stationarity and nonlinearity jointly in the context of an unrestricted error correction model (e.g. see Katrakilidis and Trachanas (2012) and Atil et al. (2014)).

Following Shin et al. (2014), we estimated the following nonlinear asymmetric cointegrating regression:

$$\Gamma_t = \Phi^+ Q_t^+ + \Phi^- Q_t^- + \alpha_t \quad \text{Eq. 6}$$

Where $\Phi^+$and Φ^- are the long-run cointegration parameters, α_t is the error term and Q_t is a N x 1 vector of regressors (price) decomposed as:

$$Q_t = Q_0 + Q_t^+ + Q_t^- \quad \text{Eq. 7}$$

[9] Both ARDL and NARDL models were analysed using Eviews.

Where $Q_t^+ + Q_t^-$ represent the partial sum decomposition processes of positive and negative price changes in Q_t:

$$Q_t^+ = \sum_{j=1}^{t} \Delta Q_j^+ = \sum_{j=1}^{t} \max(\Delta Q_j, 0) \qquad \text{Eq. 8}$$

and

$$Q_t^- = \sum_{j=1}^{t} \Delta Q_j^- = \sum_{j=1}^{t} \min(\Delta Q_j, 0) \qquad \text{Eq. 9}$$

Finally, the NARDL model can be written as:

$$\Delta \Gamma_t = \sigma_0 + \kappa_1 \Gamma_{t-1} + \kappa_2 Q_{t-1}^+ + \kappa_3 Q_{t-1}^- + \sum_{j=1}^{u-1} \forall \Delta \Gamma_{t-1} + \sum_{j=0}^{v-1} (\mu_j^+ \Delta Q_{t-1}^+ + \mu_j^- \Delta Q_{t-1}^-) + \mu_t \qquad \text{Eq. 10}$$

While all other variables are previously defined, u and v are lag orders, and $\kappa_2 = \frac{-\kappa_1}{\Phi^+}$, $\kappa_3 = \frac{-\kappa_1}{\Phi^-}$ represents the long-run impacts of price increases and decreases in the pairs of market prices. $\sum_{j=0}^{v-1} \mu_j^+$ measures the short-run influence of price increases on the respective price series. The short-run influence of price reduction is explained by $\sum_{j=0}^{v-1} \mu_j^-$. Hence, in this framework, besides the long-run asymmetric relationship, the asymmetric short-run effects between the respective price pairs are also captured (Shin et al., 2014).

The asymmetric ARDL cointegration technique is applied through three steps. The first step is the estimation of the regressors (price) Q_t, which are decomposed into Q_t^+ and Q_t^- , using an ordinary least squares model. The second step involves estimating the long-run relationships between the levels of the variables Γ_t, Q_t^+, Q_t^- (unrestricted error correction mechanism regression). The relationship is subsequently tested by means of a modified F-test by applying the bounds-testing procedure developed by Pesaran et al. (2001), which refers to the joint null hypothesis of no cointegration, $\kappa_1 = \kappa_2 = \kappa_3 = 0$. Finally, step three tests for the presence of long- and short-run (a)symmetry using the Wald test. In other words, (i) long-run symmetry where $\kappa_2 = \kappa_3$, and (ii) short-run symmetry in which $\sum_{j=0}^{v} \mu_j^+ = \sum_{j=0}^{v} \mu_j^-$ for all v = 0...,n.

3.5 Results

3.5.1 Stationary test

Production and supply of agricultural commodities tend to have a seasonal variation which gears prices into non-stationary patterns (Sorensen, 2002). Table 3.1 displays the results of the Augmented Dickey-Fuller (ADF) test which is used to determine whether or not the series are stationary. As can be seen from table 3.1, all prices in both the pre- and post-ECX periods were stationary at the first difference. Hence, the null hypothesis of unit root is rejected and it is safe to conclude that all the variables become stationary at the first difference and they are integrated in order one I(1).

Table 3.1 Result of the unit root tests using Augmented Dickey–Fuller test for Ethiopian and international traded coffee prices

Type of coffee series	At level/ First difference	Augmented Dickey–Fuller statistics			
		Pre-ECX		Post-ECX	
		Drift	Trend	Drift	Trend
Brazilian Naturals	Level	-1.93	-0.92	-1.66	-1.31
	First difference	-9.25***	-9.29***	-6.95***	-7.11***
Colombian Milds	Level	-0.99	-1.85	-1.94	-2.23
	First difference	-8.90***	-8.97***	-5.59***	-5.73***
Other Milds	Level	-1.37	-2.47	-1.84	-2.09
	First difference	-8.84***	-8.86***	-5.28***	-5.35***
Robustas	Level	-0.82	-2.59	-1.66	-1.72
	First difference	-8.18***	-8.45***	-6.42***	-6.40***
Harar	Level	-1.32	-2.53	-1.87	-1.17
	First difference	-9.53***	-9.88***	-11.62***	-11.83***
Yirgacheffe	Level	-2.41	-2.97	-1.41	-1.57
	First difference	-15.22***	-15.15*	-11.76***	-11.70***
Sidama	Level	-1.96	-2.73	-1.45	-1.48
	First difference	-10.91***	-11.81*	-8.07***	-8.01**8
Jimma	Level	-1.25	-2.48	-1.70	-1.75
	First difference	-11.54***	-11.63*	-12.00***	-11.93***

Note: ***, **, *, indicate statistical significance at 1%, 5% and 10% respectively.

3.5.2 Cointegration tests between prices of Ethiopian and internationally traded coffees

The NARDL estimates for this study indicate that the null hypothesis of no cointegration of all market pairs cannot be rejected in both pre- and post-ECX periods (see Appendix I). This suggests that the assumptions made by NARDL to capture the nonlinear cointegration between Ethiopian and international coffee prices were not met and the NARDL model failed to explain the asymmetric price relationships of the four Ethiopian coffees with the international coffees. Since we failed to find long-run cointegration using the nonlinear cointegration models, linear models were tested using an ARDL model.

As previously mentioned, the ARDL model is preceded by a test of optimal lag length (Table 3.2). In search of the optimal lag lengths, a general-to-specific testing approach is used, considering a maximum lag of 4. In order to identify the cointegration between the different types of Ethiopian coffee, the price series for each type of coffee was paired with the price series for each of the four international coffee groups (Robusta, Other Milds, Colombian Milds, and Brazilian Naturals). All price series in the two time-periods were integrated in the same order of integration, which is a precondition for the cointegration analysis.

The results of the ARDL models in Table 3.2 show that during the pre-ECX period, the prices of the four Ethiopian coffee types established a long-run cointegration with the prices of the Arabica coffee types (Other Milds, Colombian Milds and Brazilian Naturals) fetched on the international market. The lack of price cointegration for Yirgacheffe and Harar coffee with Robusta was not a surprise due to their premium Arabica nature. Furthermore, Jimma and Sidama coffee prices cointegrated with Robusta coffee in the long run. Table 3.3 provides a summary of the results comparing all four types of Ethiopian coffee with coffee types from the international market.

Table 3.2 Tests for cointegration between the prices of Ethiopian coffees with coffees on the world market using the ARDL approach

Ethiopian coffee	Coffee type	ARDL			
		Lag order	Pre-ECX	Lag order	Post-ECX
Yirgachefe	Robusta	2,0	4.52	2,4	1.35
	Other Milds	2,0	8.19	2,0	9.78
	Colombian	2,0	8.16	2,0	5.92
	Brazilian Naturals	2,0	8.96	2,1	11.25
Jimma	Robusta	1,1	4.98	2,0	4.34
	Other Milds	1,3	19.1	2,1	11.88
	Colombian	1,3	6.19	2,1	8.08
	Brazilian Naturals	1,3	20.93	1,3	20.84
Sidama	Robusta	2,2	6.65	1,0	3.02
	Other Milds	2,1	11.24	1,0	8.38
	Colombian	3,4	12.67	1,0	4.83
	Brazilian Naturals	2,1	6.94	1,1	11.71
Harar	Robusta	2,0	4.13	2,0	1.56
	Other Milds	1,0	7.64	3,3	4.22
	Colombian	1,0	10.85	4,3	4.87
	Brazilian Naturals	1,0	7.22	3,3	4.07

Note: (1) 4.78, 5.73 and 7.84 are the critical F statistic values for the ARDL at 10%, 5% and 1% respectively.

Most Ethiopian coffee prices did not cointegrate with the Robusta coffee price. This finding is not surprising since all Ethiopian coffees are Arabica by nature and the international coffee markets for Arabica and Robusta coffees started to behave differently in 2008 (see figures 3.1-3.4). Further results indicate that Yirgacheffe, Sidama, and Jimma coffee prices were cointegrated with the international prices for Other Milds coffees, Colombian Milds, and Brazilian Naturals in both the pre-ECX and post-ECX periods. Furthermore, the price of Harar coffee did not cointegrate with the prices of any of the other coffees in the post-ECX period. As shown in figure 3.1, Harar coffee prices tend to follow their own pattern and have deviated from the other coffee types, especially since 2011.

Harar coffee has a particular market, as a large share is exported to Saudi Arabia. Moreover, contrary to all other Ethiopian coffees, Harar coffee is exported as dried processed coffee. Harar coffee beans do not pass through wet processing due to the limited availability of water in the production region. However, the government promotes the wet processing method, as the quality of the coffee can be enhanced by washing instead of dry processing. Moreover, washing preserves the intrinsic quality of the bean better than the dry method, and the process results in homogenous coffee with fewer defective beans (Adugna et al., 2008). As such, Harar coffee can be considered to be a coffee traded in a niche market, outside the international market. Therefore, it is not surprising that its price does not cointegrate with that of other coffees.

Table 3.3 Summary of ARDL cointegration tests of Ethiopian coffee prices with world market prices

Ethiopian coffee	Coffee type	Pre-ECX	Post-ECX
Yirgacheffe	Robusta	Not cointegrated	Not cointegrated
	Other Milds	Cointegrated	Cointegrated
	Colombian	Cointegrated	Cointegrated
	Brazilian Naturals	Cointegrated	Cointegrated
Jimma	Robusta	Cointegrated	Not cointegrated
	Other Milds	Cointegrated	Cointegrated
	Colombian	Cointegrated	Cointegrated
	Brazilian Naturals	Cointegrated	Cointegrated
Sidama	Robusta	Cointegrated	Not cointegrated
	Other Milds	Cointegrated	Cointegrated
	Colombian	Cointegrated	Cointegrated
	Brazilian Naturals	Cointegrated	Cointegrated
Harar	Robusta	Not cointegrated	Not cointegrated
	Other Milds	Cointegrated	Not cointegrated
	Colombian	Cointegrated	Not cointegrated
	Brazilian Naturals	Cointegrated	Not cointegrated

3.5.3 Long-run price adjustment and speed of adjustment

The results for the long-run adjustment in Equation 4 and speed of adjustment (Error Correction Term models) in Equation 5 are shown in Table 3.4. In the pre-ECX period, the prices of the quality coffee types (Yirgacheffe and Sidama) showed a similar rate of adjustment to Arabica

coffee price changes in the long-run. The price of Jimma coffee, which is considered a relatively lower quality coffee among the four Ethiopian coffees, showed a slightly higher rate of price adjustment towards Arabica coffee prices. Sidama coffee prices adjusted to price deviations for Robusta coffee. However, the rate of price adjustment was not as high as for price deviations for Other Milds coffees, Colombian Milds coffees, and Brazilian Naturals. Furthermore, the adjustment rates of the prices for the Ethiopian coffee were relatively closer to the Other Milds and Colombian Milds coffees as compared to Brazilian Naturals and Robusta coffee. This implies that during the pre-ECX period, most of the price adjustments in the Ethiopian coffee prices emanated from price changes of Other Milds and Colombian Milds coffee.

During the post-ECX period, the price of Harar coffee did not cointegrate with the prices of the other types of Arabica coffee. Figure 3.1 confirms that the Harar coffee price did not follow the prices of other coffee types during this period. The price of Jimma coffee had a higher rate of price adjustment to the international price of Brazilian Naturals coffee as compared to the prices for the other Ethiopian coffees. The price cointegration of Sidama coffee with Robusta coffee in the pre-ECX period diminished in the post-ECX period. Prices for Yirgacheffe and Sidama coffee adjusted to prices for Other Milds and Colombian Milds coffee.

The price adjustment rate for most Ethiopian coffee prices in the post-ECX period was highest relative to the prices of Colombian Milds rather than Other Milds coffee, Brazilian Naturals, and Robusta coffee. Even though Ethiopian coffees are being labelled under Brazilian Naturals in the international coffee market, which is considered as an intermediate quality type in between Colombia and Other Milds coffee, the results suggest that the prices of the Ethiopian coffees are most responsive to those of the Colombian Milds type. These results imply that changes in prices of Colombian Milds coffee strongly and directly affect the price adjustments for all of the Ethiopian coffee types except for Harar coffee.

In addition, the estimates of the Error Correction Term (ECT) models are consistent with what would be expected based on the order of coffee quality (Table 3.4). The ECT was the lowest for the price of Jimma coffee relative to the prices of Arabica coffees. In the pre-ECX period, we observed that the speed of adjustment towards equilibrium between the prices for Harar and Yirgacheffe coffee and the price of Arabica coffee was the highest. The Harar coffee price returned to its equilibrium price after two months. The Sidama coffee price had a weak relationship with the Robusta coffee price, as shown by a smaller ECT. Moreover, it took four months for the Sidama coffee price to return to equilibrium.

Table 3.4 Long-run price adjustment of Ethiopian coffee prices with prices on the international markets and speed of adjustment coefficients

Ethiopian coffee	Coffee type	Pre-ECX		Post-ECX	
		Ω	ECT	Ω	ECT
Yirgacheffe	Robustas	-	-	-	-
	Other Milds	0.92***	-0.39	0.90***	-0.14
	Colombian Milds	0.97***	-0.42	1.14**	-0.10
	Brazilian Naturals	0.77***	-0.39	0.67***	-0.29
Jimma	Robustas	-	-	-	-
	Other Milds	1.34***	-0.32	0.73***	-0.31
	Colombian Milds	1.34***	-0.22	0.90***	-0.22
	Brazilian Naturals	1.10***	-0.34	0.70***	-0.65
Sidama	Robustas	0.66***	-0.26	-	-
	Other Milds	1.06***	-0.32	0.74***	-0.15
	Colombian Milds	1.10***	-0.39	0.81***	-0.12
	Brazilian Naturals	0.84***	-0.31	0.69***	-0.27
Harar	Robustas	-	-	-	-
	Other Milds	0.62***	-0.42	-	-
	Colombian Milds	0.63***	-0.52	-	-
	Brazilian Naturals	0.51***	-0.45	-	-

Note: * ** and ** indicates the significance at 1% and 5% level;

Furthermore, the speed of adjustment towards equilibrium in the post-ECX period was the highest for the price of Jimma coffee. The ECTs for Yirgacheffe and Sidama coffee prices were relatively small, which implies a weak adjustment power for the two coffees to price disequilibrium. Since Harar coffee did not establish a price cointegration, it was not possible to estimate the speed of price adjustment. This is consistent with the fact that, in the post-ECX period, the prices of quality coffees started to deviate instead of being closely determined by the prices of the other Arabica-type coffees in the world market.

3.6 Robustness test

The results of the diagnostic tests, which comprise of the serial correlation and autoregressive conditional heteroscedasticity tests, are presented in Table 3.5. The results show that the aforementioned estimation results, apart from a few observations, are free of bias that could arise due to serial correlation in the residuals and heteroscedasticity problems. Therefore, these tests suggest that the previously presented results are robust.

Table 3.5 Serial correlation and autoregressive conditional heteroscedasticity diagnostic tests

		Pre-ECX		Post-ECX	
Ethiopian coffee	Coffee type	LM	ARCH	LM	ARCH
Yirgachefe	Robusta	0.35(0.70)	3.38(0.03)	0.23(0.92)	1.09(0.36)
	Other Milds	0.45(0.63)	3.15(0.04)	0.36(0.69)	0.82(0.44)
	Colombian	0.38(0.68)	3.07(0.05)	0.38(0.68)	0.22(0.79)
	Brazilian Naturals	0.44(0.64)	3.01(0.05)	0.85(0.42)	0.95(0.39)
Jimma	Robusta	0.30(0.73)	0.71(0.39)	0.008(0.99)	0.13(0.87)
	Other Milds	0.75(0.52)	0.43(0.72)	1.29(0.28)	0.21(0.80)
	Colombian	1.69(0.17)	0.37(0.76)	0.45(0.63)	0.03(0.96)
	Brazilian Naturals	0.58(0.62)	0.41(0.74)	0.33(0.79)	0.42(0.73)
Sidama	Robusta	0.04(0.95)	3.27(0.04)	1.17(0.31)	0.35(0.55)
	Other Milds	0.31(0.73)	2..06(0.13)	0.02(0.97)	0.03(0.85)
	Colombian	1.59(0.18)	1.66(0.16)	0.11(0.88)	0.02(0.88)
	Brazilian Naturals	0.38(0.68)	1.90(0.15)	0.49(0.61)	0.07(0.79)
Harar	Robusta	1.59(0.20)	0.58(0.55)	1.65(0.19)	0.10(0.95)
	Other Milds	1.54(0.21)	5.57(0.01)	0.86(0.46)	1.25(0.29)
	Colombian	0.73(0.48)	4.67(0.03)	1.35(0.25)	0.52(0.71)
	Brazilian Naturals	1.49(0.22)	4.89(0.02)	1.56(0.20)	0.41(0.74)

Note: LM and ARCH test serial correlation and autoregressive conditional heteroscedasticity

3.7 Discussion and conclusion

Ethiopia relies heavily on a limited number of commodities, such as coffee, for its foreign revenue. This study set out to investigate how the relationships between the export coffee prices

in Ethiopia and other coffee-exporting countries changed between 1998-2008 and 2008-2013 as a result of the establishment of the ECX. This was achieved by examining the cointegration between four Ethiopian export coffees (Harar, Yirgacheffe, Sidama, and Jimma) and four international coffees (Robusta, Other Milds, Colombian Milds, and Brazilian Naturals). Autoregressive distributed lag models were used to capture these patterns of cointegration using monthly price data for both the 1998-2008 (pre-ECX) and 2008-2013 (post-ECX) periods.

The establishment of the ECX could solely influence the integration of the various Ethiopian coffee prices with the international coffee prices. However, while it is difficult to isolate the influence of the ECX on the level of integration, other factors, which were not taken into account in this study, could also contribute to the degree of price integration. Thus, the present study attempts to achieve its aims by considering the establishment of the ECX as a point of reference, and by comparing the cointegration levels of prices between the two time-periods.

The ARDL test results showed that during the pre-ECX period, the prices of all types of Ethiopian coffees established a long-run cointegration with the price of Arabica coffees on the international markets. Similarly, Jimma and Sidama coffee prices cointegrated in the long-run with prices for Robusta coffee in the pre-ECX period. Furthermore, Yirgacheffe, Sidama, and Jimma coffee prices were cointegrated with the international prices for Other Milds, Colombian Milds, and Brazilian Naturals during the post-ECX period. Finally, the price of Harar coffee did not cointegrate with the prices of any of the Arabica coffee types in the post-ECX period.

Ethiopian coffee prices in the pre-ECX period adjusted more to prices of Other Milds and Colombian Milds coffee. Similarly, during the post-ECX period, market distortions in the prices of Colombian Milds strongly and directly affected the price adjustments for most of the Ethiopian coffee types. The highest price distortion signals for the Ethiopian coffee market originated from the Colombian coffee market. Distortions in the prices of the Brazilian coffees also had an important impact on the prices in the Ethiopian coffee markets. Brazil is the world's largest coffee producer and distortions in its market can easily extend to other exporting countries.

Turning to the estimated speed of adjustment, prices for lower quality Ethiopian coffee adjusted slowly to changes in the price of all Arabica coffees in the pre-ECX period. Better quality coffees seemed to adjust faster. This phenomenon changed in the post-ECX period as the reaction time taken to correct the disequilibrium error was shorter for prices of relatively lower quality Ethiopian coffees and longer for prices of premium and high quality Ethiopian coffees. For example, the price of Jimma coffee adjusted quickly to changes in the price of Brazilian

Naturals. Hence, the results imply that, during the post-ECX period, the pricing of higher and premium quality coffees began to diverge from the previously established strong linkages with other Arabica-type coffees. The prices have also become more volatile when a shock in the international commodity markets occurs.

This study proposes that the commoditization of the ECX has not limited the possibility of trademarking of the high-quality Ethiopian coffee. This can be concluded because despite online trade platforms we now observe independent behavior of prices of Ethiopian quality coffee from the international coffee markets. As highlighted by Arslan and Reicher (2010), and Leung (2014), the trademarking of the three Ethiopian coffees (Yirgacheffe, Sidama, and Harar) enabled them to increase their export price. Moreover, the trademarking and the possibility of separately marketing in the ECX commoditization program of coffee has led to a widening of price distribution and has created a parallel market for high quality coffee, which is governed by different marketing mechanisms.

The deviation of the prices for Ethiopian quality coffees, especially Harar coffee, may also be explained by the export destination of the coffees. Most Ethiopian coffee is exported to Germany, the USA, and Saudi Arabia. In particular, Harar and Wollega coffee is predominantly exported to the Saudi market. An estimated 90% of Harar coffee is exported to Saudi Arabia (unpublished raw data), which explains much of why we do not find a clear price relationship between the price of Harar coffee and that of prices in the international market. Therefore, the dominance of Ethiopian coffee in Saudi Arabian markets has created a stable and segmented market for Harar coffee. Such niche markets may be beneficial for the actors in the market, and may generate income for the producers, if the higher prices and positive price changes are transmitted all the way down to the producer markets.

Furthermore, support strategies could clearly contribute to a further differentiation of the different coffee types. Supporting and incentivising the active participation of premium and high quality coffees in the flourishing niche coffee markets could enhance the sector and its actors. In addition, the production and trade of lower quality coffee could be supported in order to achieve further integration with the international markets if this were to generate positive effects.

Chapter 4

Empirical Investigation into Spatial Integration Without Direct Trade: Comparative Analysis Before and After the Establishment of the Ethiopian Commodity Exchange

Abstract

This chapter presents a comparative analysis of the spatial price cointegration of coffee markets in Ethiopia in the pre and post Ethiopian Commodity Exchange (ECX) era using the autoregressive distributed lag (ARDL) cointegration framework. The study takes into consideration a market condition in which government policy restricts arbitrage coffee trade between coffee producing areas. Using coffee price data from 1998-2013 and applying a bounds test approach and Toda–Yamamoto Granger causality test, the study finds that the establishment of the ECX has strengthened regional integration rather than a national harmony between producer markets. We also find evidence that, since the establishment of the ECX, an opportunity was created for high quality coffee to dominate price formation while also allowing lower quality coffee producing areas to establish themselves. The study underlines the importance of market transparency and exchange of price information between producer markets.

Key words: Coffee price; Autoregressive distributed Lag; Spatial integration; Ethiopian Commodity Exchange

Based on: Demise, T., Natanelov, V., Verbeke W., & D'Haese, M., 2016. Empirical Investigation into Spatial Integration Without Direct Trade: Comparative Analysis Before and After the Establishment of the Ethiopian Commodity Exchange, The Journal of Development Studies, DOI: 10.1080/00220388.2 016.1187722

4.1 Introduction

During the period from the 1970s to the 1990s, many developing nations liberalized their agricultural marketing policies (Krueger *et al*., 1988; Benedetto et al., 2013). In line with this, the Ethiopian government has enacted comprehensive economic policy reforms over the early 1990s that have involved market liberalization, price policy and reform of parastatal organizations (Getnet, 2007). Most of the measures taken since the 1990s have mainly aimed to encourage the private sector to become actively involved in the liberalized market. The main reforms included the devaluation of the Ethiopian Birr from 2.07 to 5.1 Birr/USD in October 1992, foreign exchange auctioning, and the reduction of entry barriers. More specifically in the coffee sector, liberalization included the consolidation of all the taxes and duties formerly levied on coffee exports into a single tax family, no restrictions on the participation of private traders at auctions, (finally enabling traders to trade in washed coffee), and allowing suppliers and exporters to sell coffee domestically at market-determined prices (Gemech and Struthers, 2007).

Prior to 1991, coffee markets in Ethiopia were highly regulated and coffee producers faced implicit and explicit taxation (Worako et al., 2008). Farmers in the main coffee growing areas of Ethiopia had to supply a predetermined quota to the government (through the Ethiopian Coffee Marketing Corporation) at a fixed price (Gemech and Struthers, 2007). Coffees from the different production areas were transported to the central market in Addis Ababa or Dire Dawa for sorting, inspection and grading. In 1992 policy changes were initiated that affected coffee production and marketing. They aimed at creating a smooth playing arena for all participants in the coffee market. It was hoped that this would increase the share of the final export value, retained by coffee producers, which would give incentives to increasing the volume of production and hence of exports, eventually resulting in an increase in the total exchange earnings from coffee export (Gemech, 2007; Worako et al., 2008). The intervention was also intended to induce more market transparency between actors in the coffee supply chain and to create an integrated coffee market (Love, 2001).

Despite these structural market reforms, the coffee sector remained inefficient. More recent attempts to enhance the performance of the Ethiopian coffee market have been introduced, aimed at offering coffee producers with a reasonable price in order to stimulate productivity and growth. A study by Gabre-Madhin and Goggin (2005) suggested that development agendas should move beyond policy incentives mostly geared towards market reforms and focus more on developing markets by developing institutions to support the

marketing process, upgrade infrastructure and provide policy support. This led to a restructuring of the organizations working in the Ethiopian coffee sector and soon after, in 2008, the auction markets were replaced by the Ethiopia Commodity Exchange (ECX). The ECX was established as “an organized marketplace, where buyers and sellers would come together to trade, while being assured of quality, quantity, payment, and delivery, with the aim of organizing efficient and transparent market operations” (ECX, 2008).

In spatially integrated markets, policy interventions in one market would be transmitted to other markets (Baulch, 1997a). The transmission of price signals occurs far less in spatially separated markets (Goodwin and Piggott, 2001; Ghoshray and Ghosh, 2011). This inspired the government to establish centrally linked commodity markets in all the major coffee growing areas of Ethiopia. These ECX markets were given the responsibility for sorting, inspecting and grading coffee. In addition, the warehouses and communication services started transmitting coffee prices on a daily basis in an attempt to enhance spatial market integration (ECX, 2008). The ECX also had to overcome the risks and transaction costs associated with much Ethiopian coffee being grown in geographically remote areas. Gabre-Madhin and Goggin (2005) attributed the high transaction costs to a lack of market coordination between marketing agents, a lack of trust between different market actors and the high costs of acquiring market information. As a result of these factors, and often geographic remoteness, buyers and sellers operated within narrow market channels where they trusted the other market actors and could get access to market information. Under these conditions, market actors were obliged to conduct business across short distances, with few partners, in few markets, and the weakness of these markets starkly affected the welfare of rural households (Gabre-Madhin and Goggin, 2005). In order to create a self-coordinating market among spatially dispersed producer markets and to minimize transaction costs, the ECX has integrated warehousing and receipt systems with quality standards, mechanisms to disseminate market information to all market actors, and created a trading platform that can guarantee payment through banks (Meijerink et al., 2010).

The Ethiopian government strictly prohibited spatial arbitrage in the coffee market between production areas, even though studies such as Goodwin and Piggott (2001), Barrett and Li (2002) Lohano and Mari (2006) have shown the importance of both spatial trade and arbitrage as mechanisms for ensuring spatial integration to signal the transfer of excess demand and supply across potential markets. The motivation for the Ethiopian government prohibiting the spatial trade of coffee between different coffee producing regions was mainly informed by

the desire to protect coffee quality and prevent adulteration between different coffee types. This restriction has been in practice since 1990s. Yet, one can ask the extent these different coffee markets are integrated, without any direct trade between them. Jensen (2007) stressed the significance of information flows in promoting price cointegration in spatially separated markets. Stephens et al. (2012) have also provided evidence that information flows across markets and traders' networks can lead to the transmission of price signals between markets even in the absence of direct trade between them. This present study tests the degree of integration between the country's six spatially separated coffee producer markets during 1998-2008 (pre-ECX) and 2008-2013 (post-ECX). We hypothesize that in the uncoordinated, and fragmented Ethiopian coffee markets, market prices in the different producer areas were not integrating before the start of the ECX, and were integrating after the establishment of the ECX due to its activities in transferring price data to the different regional units and warehouses.

The degree of market integration is important in relation to market policies since the effectiveness of the policies depend on the degree of market integration. A greater degree of integration leads to better transmission of price signals, which, in turn, encourages producers to specialize, according to comparative advantage (Baulch, 1997b). Market integration measures also served as a tool to assess the degree in which markets are vulnerable to disruptive shocks (Ravallion, 1986).

The present study attempts to measure the degree of market integration between the major coffee producer areas of Ethiopia and whether and how this changed after the establishment of the ECX. It also measures the reaction time of each long-run equilibrium relation to absorb a system-wide shock. We use a persistence profile that is robust to any ordering of the variables in the system. This method, developed by Pesaran and Shin (1996), is characterized by the response of a cointegrating relation to a system-wide, rather than to an individual, shock. Persistence profiles are unique functions that allow us to quantify the degree of integration of all locations participating in the same economic market (González-Rivera and Helfand, 2001).

The remainder of the paper is organized as follows. The next section will provide briefing on the establishment of the ECX and how it operates. Section 3 describes the methodological approach used. Section 4 reports on the data sources and econometric methods. Section 5 presents the results and discussions and the last section contains the conclusions.

4.2 Background and research approach

Studies on the integration of agricultural commodity markets have either investigated the integration between central and local agricultural commodity markets or the integration of a set of regional markets and tested their integration strength (e.g. Awokuse, 2007; Gemech and Struthers, 2007; Worako et al., 2008; Ghoshray and Ghosh, 2011; Alam et al., 2012). Most studies on this topic understand the degree of market integration as the degree of integration between locations that belong to the same market and as the reaction time needed to remove disequilibria. The measures of reaction time that are most commonly used in the integration literature are the impulse response functions. An important limitation of these impulse response functions is that they are not able to differentiate or uniquely identify the relative effects of each shock when shocks to the system are correlated or occur simultaneously. When differential spatial prices occur, it is reasonable to expect correlated errors because the time series of prices are usually highly correlated (González-Rivera and Helfand, 2001). Bivariate correlations have often been used to test for spatial market integration between different markets (e.g. Jones 1973; Lele 1972; Stigler and Sherwin, 1985). However, this bivariate approach has been criticized for having methodological flaws; as it fails to recognize non-stationarity, seasonality, autocorrelation and heteroscedasticity in price data (Blyn, 1973; Granger and Newbold, 1974; Harriss, 1979; Ravallion, 1986). To overcome these shortcomings, Delgado (1986) when analyzing grain market integration, considered the seasonality of the market by controlling the problem of heteroscedasticity. Following on from Delgado's work Ravallion (1986) made a significant progress in the study of spatial market integration by using an error correction model which allowed him to distinguish between long and short run dynamics and identify seasonal components within spatial price differentials.

The methodology of Ravaillon (1986) was extended by Palaskas and Harriss (1993) and Alexander and Wyeth (1994) who developed on the non-stationarity of price series within the cointegration framework. These studies tested the degree of market integration between central and local agricultural markets using cointegration and Granger causality ordinary least squares techniques. This study uses Pesaran et al.'s (2001) cointegration approach and the Toda and Yamamoto (1995) causality testing procedure. The most widely used approaches as developed by Engle and Granger (1987), and by Johansen and Juselius (1988), need the variables under investigation to be integrated of order one. The Johansen and Julius approach cannot easily be applied to small samples and requires a certain degree of pre-testing which introduces yet

another degree of uncertainty into the analysis (Pesaran et al., 2001). The Pesaran cointegrating test procedure overcomes these problems.

The integration of the markets studied in this paper is particular in that the different spatial markets do not directly trade with each other. This is different from searching for integration based on the transaction costs associated with the movement of goods between markets (see e.g. Stephens et al., 2012). If all locations are isolated at time *t* then the prices established in the markets are autarkic. Yet, markets are unlikely to be isolated. Fackler and Goodwin (2001) described spatial price determination using a point-location model. In this approach, geographically separated locations are represented by points and these locations are connected by a set of transportation routes. With constant per unit costs of commerce, any price change in one market attributable to a local demand or supply shock should generate an equal price change in the other market through a third common market, even if the two markets are not trading with one another. This led Fackler and Tastan (2008) to argue that two produce markets could integrate without direct trade if both markets were trading with a third market. Since spatially separated producer markets incur transaction costs (mainly transport costs) the core element in establishing their spatial integration is the performance of the central market which the two producer markets trade with in transmitting the demand from the export market through the dissemination of market information and marketing facilities. On the supply side, the central market needs to be able to link the coffee supply from the respective production areas with market demand. As such, the performance of the third market in regulating the supply and demand of the spatial producer markets' prices is the key to establishing spatial integration.

The Ethiopian Commodity Exchange is structured in a way that prevents spatially separated markets from engaging in direct trade. The restriction also existed between 1998 and 2008. Ethiopia is one of the largest coffee exporting countries in the world and known for its coffees of origin, so keeping these coffee types separate is an important strategic choice (Ethiopian coffee is exported and sold as several different types including Harar, Yirgacheffe, Sidama, Wollega, Jimma and Kaffa). The regional ECX coffee markets established in the major coffee production areas are equipped with a basic marketing infrastructure (e.g. warehouses and notice boards announcing price information) and these regional coffee markets are centrally integrated with the Addis Ababa market, the common market for all the regional markets. The central market also disseminates information on the prices the coffees fetch on the export markets. In this manner information exchange among suppliers, can lead to price adjustments

even if there is no direct trade between the markets. This inspired us to investigate how important integration between these markets was between 1998 and 2008 (pre-ECX) and between 2008 and 2013 (post ECX).

The Ethiopian coffee market was studied by Dercon (1995) who analyzed the impact of liberalization on market integration and argued that market liberalization should not be solely evaluated on the basis of what happens to the price levels for consumers and producers, but should also consider the functioning of markets. He also stressed that a market integration analysis should assess the speed of price transmission changes from the main market to the peripheral markets. Negassa (1998) showed that Ethiopian grain markets exhibited a high degree of vertical and spatial integration. Tamru (2006) tested the impact of infrastructural improvements on the degree of market integration in selected regional grain markets and concluded that areas with a grain deficit were isolated from the central market while those with a surplus were well integrated, both before and after the infrastructural improvements. The issue of market integration in Ethiopia was also investigated by Getnet et al. (2005) and Getnet (2008) using the ARDL approach. In their 2005 paper, they studied spatial price transmission in Ethiopian grain markets, and found a non-spurious long-run relationship between producer and wholesale prices. They also found that the producer price is determined by the wholesale price in both the short and long term. In the 2008 paper Getnet used an ARDL approach to analyze the spatial equilibrium of Ethiopian wheat markets in the post liberalization period. The relationship they found between the central wholesale and local market provided evidence of market integration. The study also suggested that interventions at the central (Addis Ababa) market would be more effective in shaping price dynamics as interventions at the local level are costly.

More recently, Worako et al. (2008) worked on cointegration and tested the non-linearity in the coffee markets. They measured whether the deregulation of the Ethiopian coffee industry since 1992 has improved long and short-run price relationships and price transmission between spatially integrated markets. The study evaluated the spatial integration between five selected pairs of producer coffee markets and found that three of these pairs (closely located to each other) showed clear short-run price dynamics and integration, while the other, more distant pairs showed a weak interrelationship. The study also showed that transport, information, and other transaction costs were the major limiting factors for the integration of distant producer coffee markets.

The present study extends the literature on this topic, making at least two contributions. First the study investigates how spatially distant producer markets are integrated, even in the absence of direct trade between regional coffee markets. In this regard, all the studies that have investigated spatial integration without direct trade considered transaction costs as the reason for the lack of trade between spatial markets (Fackler and Goodwin, 2001; Stephens et al., 2012). This study is the first of its kind to explore price integration between markets that do not trade with each other due to a policy restriction imposed by the government. Secondly, the studies on the integration of Ethiopian coffee markets (Negewo, 1993; IFPRI, 2003; Worako et al., 2010) investigated the impact of market reform in the 1990s. To our knowledge there have been no comprehensive studies examining the impact of the establishment of the ECX on market integration.

4.3 Data sources

The data used for the study are the average monthly producer coffee prices series from the period between January 1998 and May 2013. Monthly price data for producers were collected from Central Statistical Agency (CSA) through the monthly Ethiopian Rural Agricultural Price Survey reports. The series are divided into two subseries; December 2008 is taken as the dividing point as this is when coffee trade through the ECX started. The observations from January 1998 to November 2008 are considered pre-ECX, while the post-ECX sub-series runs from December 2008 to June 2013. The price data in both periods are nominal values and are measured in Birr per kg (the local currency). The major coffee producing areas considered for this study are Kaffa, Wollega, Sidama, Yirgacheffe, Jimma, and Harar (Figure 1.2).

4.4 Econometric analysis

4.4.1 The bounds test approach to cointegration

We use the bounds testing approach to cointegration in the Autoregressive Distributed Lag (ARDL) framework developed by Pesaran et al. (2001). This approach is explained in chapter three section 3.4.2.

4.4.2 The Toda–Yamamoto approach to the Granger causality test

To further examine the role of the ECX in the domestic coffee market, we use Toda and Yamamoto's (TY) (1995) methodology of bivariate systems to test the causality relationship of

one coffee producer market price predicting the other coffee producer market prices. The TY approach has the advantage of avoiding problems related to the non-stationary of the price series while testing for price causality and fitting a standard Vector Autoregression (VAR) model in the levels of the variables, which reduces the possibilities of incorrectly identifying the orders of integration of the series, or the presence of cointegration (Giles and Mizra, 1998; Mavrotas and Kelly, 2001). Toda and Yamamoto (1995) have shown that the conventional F-statistics of the Granger non-causality test are not valid as the test does not have a standard distribution. Accordingly, our study employs a Modified Wald (MWALD) procedure to test for restrictions on the parameters of the VAR(p) model. Under this approach the test follows an asymptotic chi-squared distribution with p degrees of freedom to estimate the VAR [w + dmax] with dmax being the maximum order of integration.

The empirical implementation of the TY approach involves three steps. The first step consists of determining the maximum order of integration (dmax). The second step is to determine the optimal lag length (w). Since this not known in the time series, it has to be obtained by using the different lag length criteria in the levels. In the third stage, a VAR (w) model for causality is estimated using the modified Wald-technique. In the present study, TY Granger non-causality test is performed using the following VAR model:

$$Pn_t = \partial_0 + \sum_{j=1}^{w} \partial_{1j} Pn_{t-j} + \sum_{i=w+1}^{d_{max}} \partial_{2i} Pn_{t-i} + \sum_{j=1}^{w} \varphi_{1j} Pm_{t-j} + \sum_{i=w+1}^{d_{max}} \varphi_{2j} Pm_{t-i} + \mho_{lt} \qquad \text{Eq. 1}$$

Where from Eq. 1, Granger causality from market m to n implies $\varphi_{1j} \neq 0 \ \forall_j$.

4.5 Persistence profile

The persistence profile technique developed by Pesaran and Shin (1996) is employed to model the time profile of the response of the cointegrating relation $V_x = \beta' \mathrm{Y}\mathrm{x}$ to system-wide shocks. A system-wide shock is analyzed via a draw from a multivariate distribution of the vector. The study analyzes the propagation through time (x+1, x+2) of the variance of the shock, based on information available at time x-1. Hence, with the market policy reform in the spatial coffee market at time x, observing the market information at time x-1, the persistence profile analysis emphasizes the additional variance of the disequilibrium error from time x+1 to x+p. Pesaran and Shin (1996) define a persistence profile as:

$$H_v(p) = \mathrm{Var}\left(V_{x+p}\middle|\alpha_{x-1}\right) - \mathrm{Var}\left(V_{x+p-1}\middle|\alpha_{x-1}\right)\ p\ =\ 0, 1, 2, \ldots \qquad \text{Eq. 2}$$

Where, α_{x-1} is the information set at time *x-1*, $\mathrm{Var}\left(V_{x+p-1}\middle|\alpha_{x-1}\right)$ is the variance of V_{x+p} conditioned by the information set, $\mathrm{V_{x+p}}$ is the time profile of the response, and p is the time limit. The persistence profile is the change in the variance of the V_{x+p}forecast, compared to the variance of V_{x+p-1} forecast, based on the information set α_{x-1}. In a stationary equilibrium, a shock will eventually diminish. This suggests that its additional variance becomes smaller over time and nears zero as time goes towards infinity. The examination of the speed with which the incremental variance approaches zero indicates how long it will take the system to return to the long-run equilibrium after a shock (Pesaran and Shin, 1996). This is defined as

$$h_v(p) = GH_v(p)G = \left\{h_{ij}(p)\right\}\ p\ =\ 0, 1, 2\ \ldots\ldots \qquad \text{Eq. 3}$$

Upon impact, at time p = 0, the matrix G represents a suitable scaling matrix, the profile $h_{ij}(p) = 1 \qquad \text{for } i\ =\ 1, 2\ \ldots\ldots, \mathrm{p} - 1.$

4.6 Empirical results

This paper attempts to establish the long-run relationship, the causal relationship and the degree of integration between the spatial coffee producer markets and does this in four steps. First, the ARDL approach (Pesaran et al. 2001) is used to test cointegration. Second, the study compares the cointegration of the price series before and after the ECX was established, defining two price series (before and after ECX). Third, the Toda and Yamamoto (1995) Granger non-causality technique is used to observe the price causality between the six producer markets. Unlike other causality tests, this procedure is valid irrespective of the level of integration. Fourth, to test the time profile of the response of the cointegrating relation to system-wide shocks, the study uses the persistence profile technique developed by Pesaran and Shin (1996).

4.6.1 Stationary analysis

Figures 4.1 and 4.2 show the price evolution of the distinct coffee producers' market prices, before (1998-2008) and after (2008-2013) the establishment of the ECX. Harar coffee, which is considered to be of the superior quality, commands a premium on the Ethiopia coffee market. The figures show that coffee prices became more volatile after 2006.

Before proceeding with the ARDL bounds tests, we had to ensure that none of the variables under consideration were integrated to an order higher than one. In case of an higher

order of integration (I(2) or higher), the computed statistics provided by Pesaran et al. (2001) and Narayan (2005) are not valid (Ang, 2007). Hence, it is necessary to test for unit roots to make sure that the variables included in the study obey the assumptions of the ARDL bounds testing approach of cointegration. Table 4.1 shows the results of an Augmented Dickey-Fuller (ADF) test for the two price series. The unit root test was performed at level and at first difference with the intercept, and with the intercept and trend term. The optimum lag was selected using the Schwartz Information Criterion (SIC). Based on the critical values reported, some price series appear to be non-stationary in the levels, while others are stationary in the levels both pre and post ECX. No series had an integration order of I(2) or more.

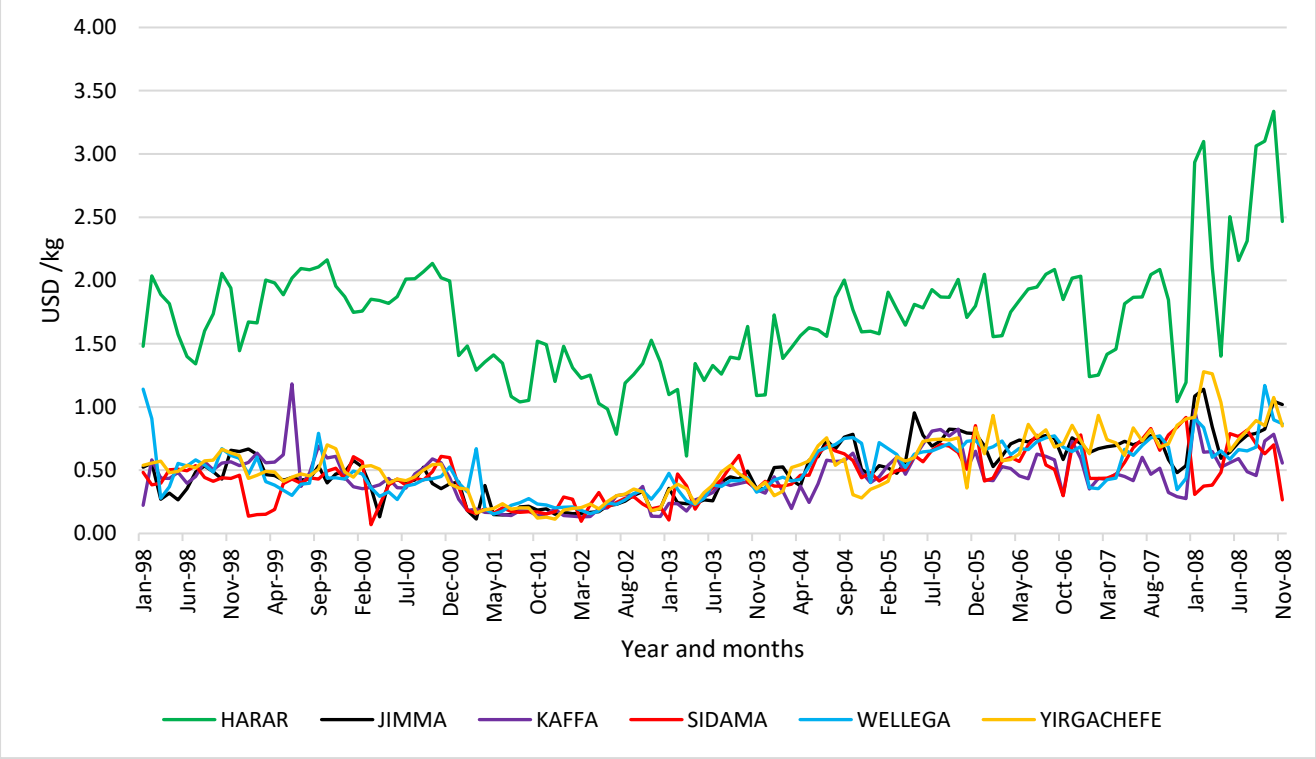


Figure 4.1 Price paid to producers for coffee 1998-2008 (USD/kg)

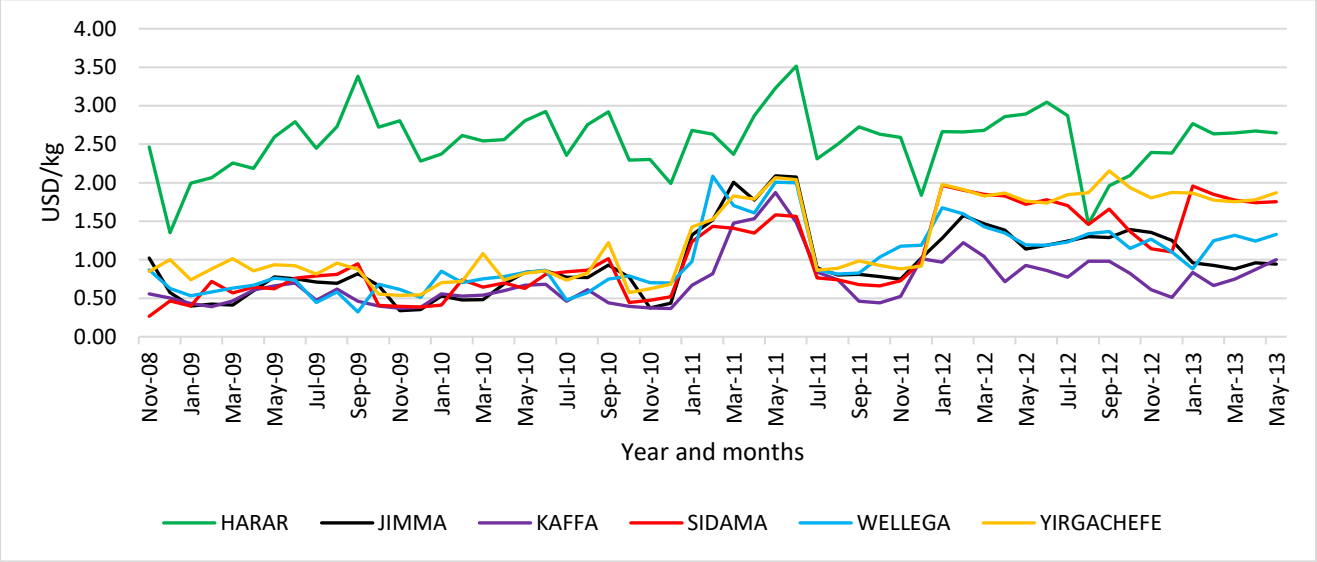


Figure 4.2 Price paid to producers for coffee 2008-2013 (USD/kg)

Table 4.1 Unit root test result

Variable (Price)	At level/ First difference	Period 1998 – 2008			Period 2008 -2013		
		ADF statistics		Order of integration	ADF statistics		Order of integration
		τ_c	$\tau_{c,t}$		τ_c	$\tau_{c,t}$	
Harar	Level	-1.84	-4.42***	I(1)	-4.83***	-4.84***	I(0)
	Difference	-9.8***	-9.96***		-	-	
Kaffa	Level	-3.25**	-3.73**	I(0)	-3.74***	-4.39***	I(0)
	Difference	-	-		-	-	
Sidama	Level	-4.17***	-5.48***	I(0)	-2.1	-3.44*	I(1)
	Difference	-	-		-7.28***	-7.21***	
Wollega	Level	-3.65***	-5.58***	I(0)	-2.53	-3.48*	I(1)
	Difference	-	-		-7.8***	-7.73***	
Yirgacheffe	Level	-1.02	-3.08	I(1)	-2.0	-3.4*	I(1)
	Difference	-9.56***	-9.58***		-7.86***	-7.79***	
Jimma	Level	-1.20	-2.64	I(1)	-2.30	-3.31*	I(1)
	Difference	-9.82***	-9.85***		-6.3***	-6.24***	

Notes: ***, **, and ***,** indicate statistical significance at 1%, 5% and 10% respectively

4.6.2 ARDL bounds tests for cointegration

The first step in the ARDL bounds test is to estimate the presence of a long-run relation among coffee price series, yet before that it is important to ascertain the appropriate lag length is chosen

as the model is sensitive to any variations in lag order. The lag order should be high enough to reduce the consequences of residual serial correlation but low enough for the conditional Error Correction Model to not be subject to problems with over-parameterization (Pesaran et al., 2001; Narayan, 2005; Ang, 2007). We used the Akaike Information Criterion (AIC) and Schwarz's Bayesian Criterion (SBC) to select the optimal lag order and carried out misspecification tests including tests for autocorrelation and stability. Based on selection criteria results the optimal lag lengths were different for most market pairs. The absence of any residual serial correlation suggests that we selected the correct lag order. Since there were thirty pairs of producer markets, the optimal lag lengths are not presented here but can be provided upon request.

The hypothesis of the ARDL bounds testing is the null of no long-run relationship between a pair of coffee producer market prices against the alternative of the existence of cointegration. Table 4.2 shows the cointegration results. Pesaran et al. (2001) critical bounds are used to take decisions as to whether cointegration exists or not. For both 1998-2008 and 2008- 2013 periods, twenty one out of the thirty pairs of producer markets were found to be cointegrated in the long run. Of the pairs in the post ECX period Harar and Sidama tended to move together with all the markets. While in the pre ECX period Wollega and Sidama established a cointegration with all the markets.

While interpreting the results on cointegration before 2008 it is important to keep in mind that prior to the establishment of the ECX, the government sought to trade different coffee types, each with its assured quality. Almost all the coffees from all the production areas were supplied to the central market for auction. However, a significant volume of coffee was adulterated by mixing high quality coffees with low quality ones. Coffee markets that were located close to each other received similar prices even if they had different quality coffees. Furthermore, the locations of the warehouses in the central market made it possible for suppliers to manipulate the trading activities of the auction center by reaching informal agreements with the exporters (ECX, 2008). For all these reasons, the coffee markets were easily manipulated and artificially integrated markets were created. After 2008 (with the ECX) we explain possible market integration through all regional coffee markets trading with the common central market and a more intensive dissemination of price information throughout the different producer regions. Table 4.2 gives the long-run coefficients of the market pairs that established a long-run relationship. The results for both pre and post-ECX periods are based on significance levels of up to 10%.

Generally, the south-western producer markets, Jimma, Kaffa and Wollega show a similar degree of market integration in the pre and post-ECX periods. Looking in more detail at these markets, the one in Jimma possessed a higher degree of market integration in the pre-ECX period than Wollega and Kaffa and the market in Wollega was more integrated in the post-ECX period. Another interesting observation is the market at Sidama is integrated with those at Wollega and Kaffa. The degree of market integration stimulated in the Sidama producer market declined in post-ECX period. Overall however, these results provide evidence of higher levels of regional integration in the post-ECX period.

Despite a similar degree of market integration between Sidama and Yirgacheffe in the two periods, a slight difference between the two periods can be observed. The degree of market integration initiated by Sidama coffee was higher in the pre-ECX than in the post-ECX period. By contrast, the market integration of Yirgacheffe was higher in the post-ECX period. Unit price changes in the Yirgacheffe, Sidama and Jimma producer markets had more effect on prices in the Harar producer market in the pre-ECX period than in the post-ECX period. Finally, a unit price change in the Harar producer market price led to a small positive change on the Sidama and Kaffa producer markets in the pre-ECX period but small negative change in the post-ECX period. These results more or less testify that higher quality coffee markets initiate higher degree of market integration to their respective producer markets.

While looking at the market integration for the period between 2008 and 2013, producer prices at Sidama and Yirgacheffe seem to respond to price changes at each other and tend to move in tandem. The long run coefficients (0.88 & 0.98) show, a price change in one of the market stimulates the other to a similar extent. However, neither of these markets is price leaders: rather

Table 4.2 Tests for cointegration using the ARDL approach

Market pair	1998-2008 Period				2008-2013 Period			
	ℓ	F stat	Long-run coefficient	ect_{t-1}	ℓ	F statistics	Long-run coefficient	ect_{t-1}
Jimma–Kaffa	4,4	0.82	-	-	2,0	5.47*	1.17	-0.62
Jimma–Wollega	4,0	3.06	-	-	1,0	5.73**	1.01	-0.60
Wollega–Jimma	1,0	21.11***	0.77	-0.69	1,2	16.98***	0.56	-0.76
Wollega–Kaffa	2,3	7.92***	1.08	-0.29	1,0	22.28***	0.86	-0.93
Kaffa–Wollega	2,2	11.86***	0.66	-0.44	1,1	22.93***	0.88	-0.75
Kaffa–Jimma	2,1	14.91***	0.60	-0.52	3,2	12.57***	0.59	-0.81
Sidama–Yirgacheffe	2,3	19.24***	0.60	-0.55	1,1	7.29***	0.88	-0.43
Yirgacheffe–Sidama	4,2	6.44**	1.33	-0.22	1,1	8.69***	0.98	-0.46
Yirgacheffe–Harar	4,3	1.37	-	-	1,1	7.40***	-0.41	-0.31
Sidama–Harar	1,2	11.22***	0.22	-0.33	2,4	9.32***	-0.02	-0.46
Harar–Sidama	3,2	7.74***	2.12	-0.30	1,1	7.35***	0.31	-0.51
Harar–Yirgacheffe	4,0	5.08*	1.75	-0.29	1,1	7.04***	0.39	-0.48
Harar–Jimma	3,1	9.31***	1.90	-0.35	1,0	12.18***	0.38	-0.66
Harar–Kaffa	4,2	3.87	-	-	1,0	14.78***	0.43	-0.65
Harar–Wollega	3,2	4.29	-	-	1,0	11.57***	0.29	-0.64
Yirgacheffe–Wollega	4,3	1.47	-	-	1,1	6.06**	1.15	-0.35
Wollega–Yirgacheffe	1,1	20.59***	0.67	-0.47	1,2	8.19***	0.53	-0.45
Wollega–Sidama	1,3	25.21***	1.01	-0.54	1,2	6.40**	0.53	-0.41
Jimma-Harar	3,1	8.71***	0.30	-0.29	1,2	3.69	-	-
Jimma – Yirgacheffe	4,1	11.49***	0.94	-0.37	2,3	3.99	-	-
Jimma-Sidama	3,1	9.51***	1.20	-0.24	1,2	3.13	-	-
Sidama–Jimma	1,3	15.26***	0.61	-0.47	1,1	3.31	-	-
Sidama-Wollega	1,1	12.52***	0.56	-0.47	1,0	2.62	-	-
Sidama – Kaffa	1,0	10.31***	0.57	-0.34	1,3	2.29	-	-
Yirgacheffe -Jimma	4,3	4.19	-	-	3,2	0.78	-	-
Yirgacheffe – Kaffa	4,0	0.82	-	-	3,2	0.64	-	-
Wollega-Harar	3,2	5.10*	0.40	-0.24	1,1	2.96	-	-
Kaffa – Sidama	3,0	6.08**	0.62	-0.31	3,1	7.63***	0.31	-0.42
Kaffa- Yirgacheffe	4,4	4.35	-	-	3,1	8.40***	0.34	-0.47
Kaffa - Harar	3,1	8.55***	0.30	-0.35	3,0	7.80***	-0.08	-0.33

Notes: ***, ****, *,** indicate statistical significance at 1%, 5% and 10% respectively. Optimal number of lags is denoted by ℓ. ect_{t-1} stands for error correction term; from the market pair the first variable is the dependent variable followed by regressor. Example, the number 4, 4 under optimal lag number of Jimma–Kaffa refers to optimal lag of 4 for Jimma and 4 for Kaffa respectively. The first six market pairs are located in south west part of Ethiopia. The 7th and 8th pairs are located in the southern Ethiopia. The bold market pairs represent the high-quality coffee markets. The last three market pairs indicate the low-quality coffee establishing a cointegration.

they exhibit bi-directional causality. This is because both are premium coffees grown in neighboring areas. This finding suggests that there is a good exchange of information about prices between them. They also have access to relatively good road networks and communications services. The speed of adjustment of Sidama coffee prices to changes in Yirgacheffe (43%) and of Yirgacheffe to changes in the price at Sidama (46%), to deviations from the long-run price levels occurred in less than three months.

The Jimma and Wollega coffee production areas are located next to each other in the southwestern part of the country. One would expect a strong flow of information between the two markets and this would contribute for the quick adjustment of prices on both market prices to deviations from their long-run equilibrium. The long run estimate coefficient between Jimma and Wollega shows that a 1 birr increase in the Wollega price leads to a 1.01 birr increase in the Jimma coffee price, but the same change in Wollega stimulates a lower increase (0.56 birr) in Jimma. This is consistent with Wollega coffee having a substantially higher quality than Jimma coffee. The speeds of adjustment in regaining equilibrium between these two markets are fast and significant (60% and 76%). Kaffa is also located in the same area as Jimma and Wollega. Because there are strong flows of information between these districts, they have established long-run price movements with each other and act as a regional market.

The cointegration test results show that producer markets with low coffee quality were able to establish a long-run relationship with the markets of high-quality coffee between 2008 and 2013. For example, Kaffa and Jimma induced a long-run relationship with the Harar coffee market. Most importantly, during this period Harar coffee producing areas were more differentiated than before, with some more noticeably establishing themselves as price leaders and establishing a long-run relationship in the market. After the establishment of the ECX low-quality coffee areas clearly became price followers.

4.6.3 Toda and Yamamoto causality test results

Toda-Yamamoto causality tests were employed in order to determine whether there are any causal relationships in prices among cointegrated markets and to explore the direction of causality in bivariate systems. This test uses a modified Wald (MWALD) test which can be applied irrespective of whether the underlying variables are I(0) or I(1). The first step towards determining the maximum order of integration for a price series is to apply MWALD tests. As depicted in Table 4.1, the unit root test results for the price series show that the maximum order

of integration is one I(1) therefore d_{max} is one for both the time series analyzed. The Akaike Information Criterion and Schwarz Bayesian Criterion were used to select the optimal lag length. The sum of the optimal lag length (p) and maximum of integration (d_{max}) was used by Toda and Yamamoto (1995) to determine the order of the estimated VAR system (k) to empirically specify the Var ($k = p + d_{max}$) model. After estimating the model the MWALD test was conducted to examine the causality of the relationships among the producer market prices.

Table 4.3 reports the chi-squared test statistic results together with the estimated p-values for the periods under consideration. The p-values of the MWALD statistics suggest that there was causality for all the market pairs in the both periods (1998-2008 and 2008-2013). In the pre- ECX period, thirteen market pairs (out of the fifteen we studied) exhibited a uni-directional price relationship, and just two established a bi-directional price relationship. During this period, Yirgacheffe, Harar and Wollega were the main price leaders influencing prices on most of the producer markets.

One of the main reasons for establishing the ECX was to create a transparent market between the producers' markets located in different areas so that they would all be integrated with each other. To achieve this, the ECX established infrastructure and means of communications in the major producing area to provide daily information on domestic and world coffee prices. This has enabled all the producer markets to have daily access to coffee prices in the hope that they would follow a similar price setting strategy. There was a bidirectional feedback relationship between the Wollega market price and those at Jimma and Kaffa. This indicates that the price in either market (Wollega or the other two) reacts to simultaneous shocks from its long-run equilibrium path in the others. While the southwestern coffee markets (Jimma, Wollega and Kaffa) are located far away from Harar (on average 840 km), a price feedback relationship was also established between these markets in both periods.

Table 4.3 Granger non –causality test results

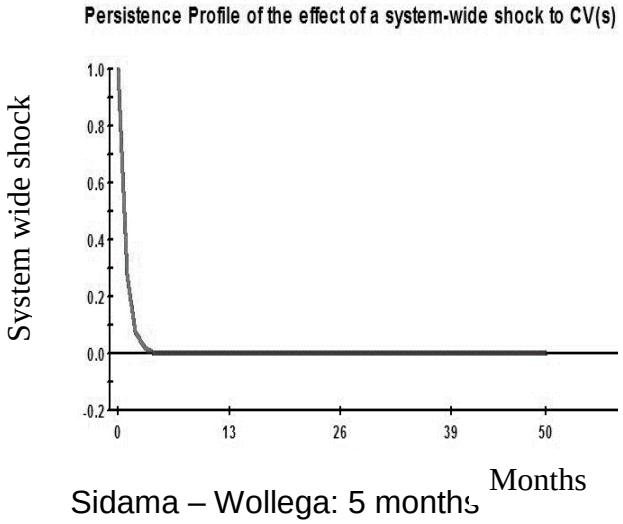
Hypothesis	1998-2008 Period		causality	2008-2013 Period		causality
Kaffa -Wollega	4.89	13.64		27.7	26.7	
	(0.17)	(0.00)	W →K	(0.00)	(0.00)	K↔W
Jimma- Wollega	0.91	8.63		37.0	12.6	
	(0.33)	(0.00)	W→J	(0.00)	(0.08)	J↔W
Jimma-Kaffa	2.75	0.59		2.18	4.41	
	(0.09)	(0.43)	J→K	(0.13)	(0.03)	K→J
Sidama- Yirgacheffe	3.12	7.2		0.005	5.02	
	(0.2)	(0.02)	Y→S	(0.93)	(0.02)	Y→S
Harar-Sidama	5.59	2.66		8.4	0.87	
	(0.06)	(0.26)	H→S	(0.00)	(0.34)	H→S
Harar -Yirgacheffe	2.07	2.72		9.27	0.96	
	(0.14)	(0.09)	Y →H	(0.00)	(0.32)	H→Y
Harar-Jimma	3.73	0.80		2.40	9.62	
	(0.05)	(0.36)	H→J	(0.49)	(0.02)	J→H
Harar-Kaffa	5.42	1.81		2.46	9.67	
	(0.01)	(0.71)	H→K	(0.29)	(0.00)	K→H
Harar-Wollega	7.25	2.40		6.4	1.0	
	(0.00)	(0.12)	H→W	(0.09)	(0.8)	H→W
Wollega - Yirgacheffe	10.3	15.1		0.88	4.53	
	(0.00)	(0.00)	W→Y	(0.3)	(0.03)	Y→ W
Jimma -Yirgacheffe	5.78	6.33		0.43	2.72	
	(0.01)	(0.01)	Y↔J	(0.50)	(0.09)	Y→ J
Jimma -Sidama	0.47	8.17		0.05	3.34	
	(0.49)	(0.00)	S→J	(0.8)	(0.06)	S→J
Sidama- Wollega	5.05	3.36		7.80	0.17	
	(0.02)	(0.06)	W↔S	(0.00)	(0.67)	S→W
Kaffa -Sidama	3.92	0.27		8.24	2.05	
	(0.04)	(0.59)	K→S	(0.01)	(0.35)	K→S
Kaffa -Yirgacheffe	2.28	3.38		11.29	1.04	
	(0.13)	(0.06)	Y→ K	(0.01)	(0.78)	K→Y

Note: The value reported is Chi-sq.stat and p-value is represented in parentheses. The first three market pairs are located in south west part of Ethiopia. The 4th pair is located in the southern Ethiopia. The bold market pairs represent the high-quality coffee markets. The last two market pairs indicate the low-quality coffee.

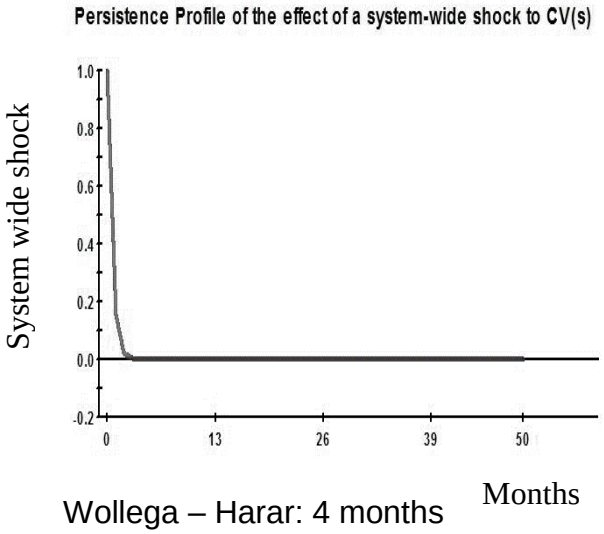
4.7 The persistence profiles test

Figure 4.4 shows the persistence profiles for the selected pairs of markets. These graphs show the estimated reaction time for each of the eight long-run equilibrium relations to absorb system wide-shocks. The figure shows the profiles over a 55 months' horizon for: Harar-Jimma; Jimma–Wollega; Kaffa-Wollega; Kaffa–Harar; Sidama-Yirgacheffe; Sidama–Wollega; Wollega–Harar.

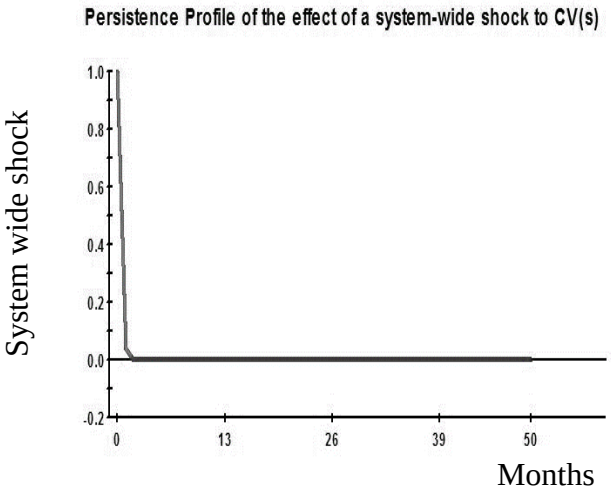
The results indicate that disequilibria between most market pairs regained equilibrium quite quickly, usually in less than 5 months. The only market pair which took six months to reestablish after a long-run disequilibrium was Sidama and Yirgacheffe.



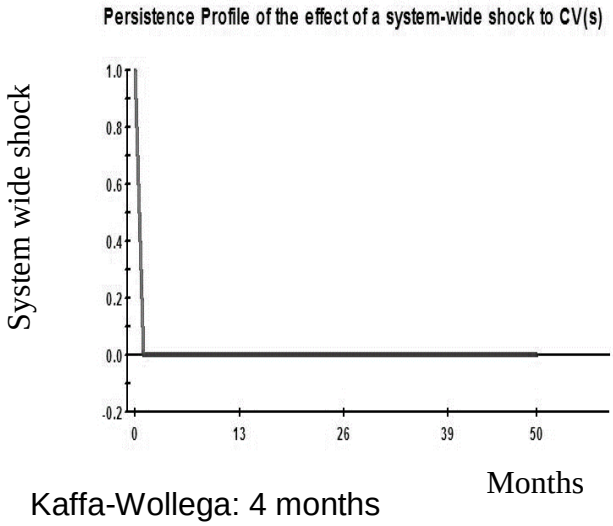
Sidama – Wollega: 5 months



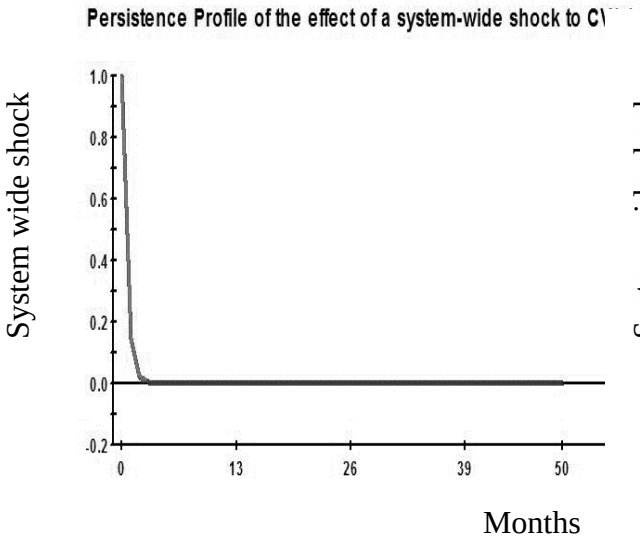
Wollega – Harar: 4 months



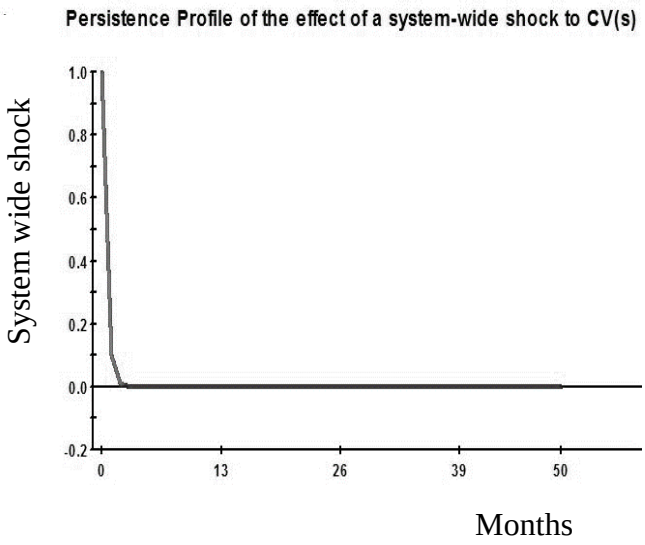
Jimma –Wollega: 3 months



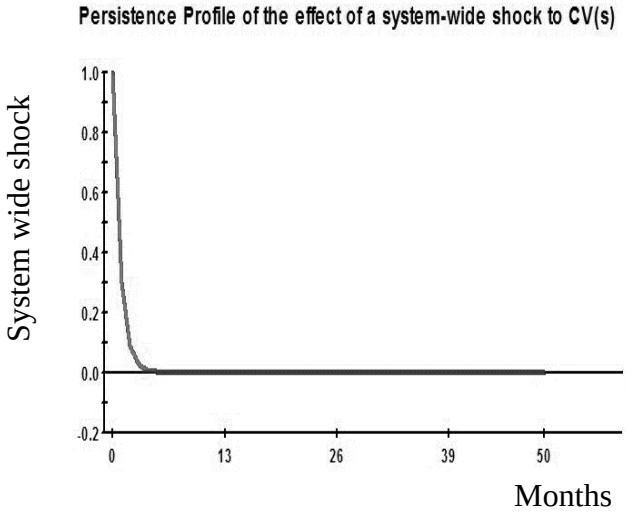
Kaffa-Wollega: 4 months



Jimma-Harar: 3.5 months



Kaffa – Harar: 4 months



Sidama- Yirgacheffe: 6 months

Figure 4.3 Persistence profiles

4.8 Conclusions

This study has set out to investigate if the levels of spatial coffee market integration in Ethiopia changed between 1998-2008 and 2008-2013 as a result of the establishment of the ECX. The study specifically examines the extent to which, despite there being a prohibition arbitrage trade between producer markets, the establishment of the ECX increased the integration of domestic coffee markets. It did so by examining the relationships between prices at six producer markets located in the major coffee producing areas of Ethiopia. Using the bounds test approach and

Toda–Yamamoto Granger non-causality test, the study estimated the long-run cointegration and granger causality between the six major coffee markets.

The results from the ARDL model show that we cannot reject the null hypothesis that there is no long-run relationship for 21 (out of 30) pairs of price series. Further, the results suggest that between 2008 and 2013, the trend was more to the regional integration of producer markets rather than to national harmonization, with the producer markets in southern and southwestern Ethiopia generally being the more integrated. The second finding is that an opportunity has been created for Kaffa coffee producing markets to establish themselves in the market. They have established a long-run but limited integration with the higher coffee quality markets. However, the market is dominated by the high-quality coffee producing markets which are traded in internationally reputable brand names. The acquisition of brand names in the international coffee market can have a causality on the dominance of the coffees at the domestic coffee market. As such, this study suggests that efforts to enhance the quality of the coffee produced in different regions of the country would not only enhance spatial market integration but also foster national market integration. There was no visible difference in the price causality results over the two periods. During the first period (1998-2008), all fifteen pairs of producer markets established a causality with their respective markets. Whereas during the second period (2008-2013), there is also for most market pairs a unidirectional granger causality and for some a bidirectional Granger causality. The direct of the unidirectional causality is not stable over the periods suggesting that the causality could also be bidirectional.

It is important to acknowledge that the study did not account for other factors that may have influenced price cointegration during the periods under study. The improved flows of information may also have resulted from an increased use of mobile phones. It is likely that such improved lines of communication amplified the impact of the ECX information services, however it was not possible to quantify this effect because of a lack of data. This may be an area for future research.

The major policy implication of this chapter is that, from 2008 onwards, quality started to take over the market and now increasingly commands the integration of markets. To strengthen the price causality between distant producer markets, it is crucial to enhance the supply of quality coffee from producers. We argue that it will more crucial to reinforce the ECX and its supporting institutions to engage in quality improvement programmes to harmonize the coffee producer markets.

Chapter 5

Market integration and price transmission under institutionalised Ethiopian coffee market: Evidence from nonlinear ARDL model

Abstract

In this chapter, market integration and price transmission along the Ethiopian coffee value chain after the introduction of the ECX is investigated. The empirical analysis applies a nonlinear ARDL cointegration methodology as developed by Shin, Yu, and Greenwood-Nimmo (2011). This model allows for more flexible prices and the establishment of asymmetric relationships both in the long- and short-run. The study aims to examine price dynamics for five Ethiopian coffee varieties at three levels, namely producer-ECX, producer-exporter, and ECX-exporter. The overall results for all three levels illustrate the limited capability of the ECX in creating an integrated and transparent market along the Ethiopian coffee value chain. The results also confirm that exporters enjoy an advantage over coffee producers. Furthermore, the evidence of price asymmetry between the producer-exporter prices for quality Ethiopian coffees could be explained by the different markets in which these coffees are traded.

Keywords: Ethiopian coffee, NARDL Cointegration, Asymmetric price transmission, Ethiopian Commodity Exchange

Based on: Demise, T., Natanelov, V., D'Haese, M. Empirical Investigation into Spatial Integration Without Direct Trade. Market integration and price transmission under institutionalized Ethiopian coffee market: Evidence from Nonlinear ARDL model. (Under review)

5.1 Introduction

Most developing countries have been through several economic reforms over the past three to four decades. These reforms have sought to remove price controls at all levels of the commodity market by liberalising trade, and privatising the government-owned agricultural enterprises. The reforms in the agricultural sector have aimed to empower producers and subsequently, enhance trade efficiency (White and Leavy, 2001). These reforms were often geared towards markets of primary agricultural commodities such as coffee, cocoa, and cotton, due to the crucial role that these commodities play in the economies of the producing countries. For example, in Ethiopia, more than 15 million people have a direct or indirect link to coffee production (ECEA, 2013).

In the early 1990s, the Ethiopian government, under pressure from the World Bank and the international monetary fund (IMF), implemented a Structural Adjustment Programme (SAP). This programme was geared towards market liberalisation, with the objectives of reducing producer price variability, protecting producers from exploitation by private middlemen and possible monopolistic practices, abolishing marketing boards, and allowing private agents to operate as traders and exporters (Worako et al., 2008). Moreover, it was hypothesised that the integration of the producers with the auction and the export market would improve the transmission of international coffee prices to domestic coffee markets, and subsequently to domestic growers. In turn, this was expected to improve coffee supply and quality. However, various studies (Gabre-Madhin and Goggin, 2005; ECX, 2008; Alemu and Worako, 2011) have shown that, like most developing countries, policy interventions in the Ethiopian agriculture sector did not deliver on what was expected of them.

Market integration studies have been particularly useful in forecasting the impact of interventions on price changes within and between markets (Abdulai, 2007). In theory, when price adjustments are not efficiently conveyed to producers, market intermediaries benefit from imperfections and from reduced market transparency (Le Goulven, 2001). More specifically, the ever-widening gap between coffee retail prices in the high-income countries and producer prices in the coffee-growing countries means that either the producers are not benefiting from consumer price increases or the consumers are not benefiting from producer price reductions. Despite the major disappointment in the policy measures for agricultural sectors in most developing countries, there is previous evidence (Krivonos, 2004; Subervie, 2011; Mofya-Mukuka and Abdulai, 2013) which suggests that in countries where interventions and reforms have been implemented successfully, producers have benefited from better price transmission

and received a larger share of export prices. As such, market reforms could improve the bargaining power of producers which would allow them to benefit more from price changes in the trader and/ or export market. Peltzman (2000), extensively investigated the asymmetric price transmission in agricultural and food product markets and criticised the standard economic market theory for ignoring the existence of asymmetric price adjustment. This criticism was too highlighted by other researchers such as Katrakilidis and Trachanas (2012), Simioni et al. (2013), and Greenwood-Nimmo and Shin (2013). Furthermore, price asymmetries in agricultural markets are mostly driven by information asymmetry, market power, adjustment cost, collusion, and consumer response to changing commodity prices (Jaffry, 2005).

Poor price signals within the different sections of the markets indicate how agricultural commodity markets are poorly integrated. High transfer costs may also arise as a result of poor market infrastructure (Rapsomanikis et al., 2003). Particularly in developing countries, poor infrastructure and communication services contribute towards larger marketing margins. This is essentially due to the high cost of delivering the locally produced commodity to the export ports, hindering the transmission of price signals, and thus, preventing arbitrage. The ECX was established as a means to overcome these marketing challenges for agricultural commodities and to revolutionise Ethiopian agriculture by creating a dynamic, forward-looking, efficient, and integrated marketing system.

The ECX was established in 2008 by the Ethiopian government as a market place where buyers and sellers could meet to trade, while being assured of quality, delivery, and payment. The ECX aims to facilitate transparency and efficiency through an innovative marketing system, which should protect the interests of all actors, including farmers, farmer groups, processors, traders, exporters, aid agencies, input suppliers, industrial buyers, and consumers. Furthermore, the ECX is particularly unique as its end-to-end integrated marketing system aims to integrate central trading, warehousing, product grade certification, clearance, delivery, and market information dissemination (ECX, 2009; Alemu and Meijerink, 2010). It also operates as a trading platform, using a combination of open outcry (floor) trading and electronic platforms (Paul, 2011).

Although the ECX was established with the aim of creating transparency and competitiveness at all levels of the coffee market, the expected level of competitiveness at the local level has not yet been achieved (Minten et al., 2014). This may be due to the structure of the Ethiopian coffee market, which, like many other agricultural markets, is composed of a large number of small-scale coffee producers and only a few traders. However, an improved level of

competition has been observed on the exporter market. According to Minten et al. (2014), the number of exporters has increased to 175 in 2012 from 100 in 2008. In addition, the shares of the largest four (CR4) and eight (CR8) exporters in the coffee market have decreased significantly during the past year. These findings were, however, refuted by the World Bank (2014) which showed that the largest exporters (selling more than 5 million USD per annum) accounted for nearly 80% of coffee exports. The World Bank (2014) argued that the Ethiopian coffee market is difficult for new entrants to penetrate and now has all the features of an oligopsonistic[10] market.

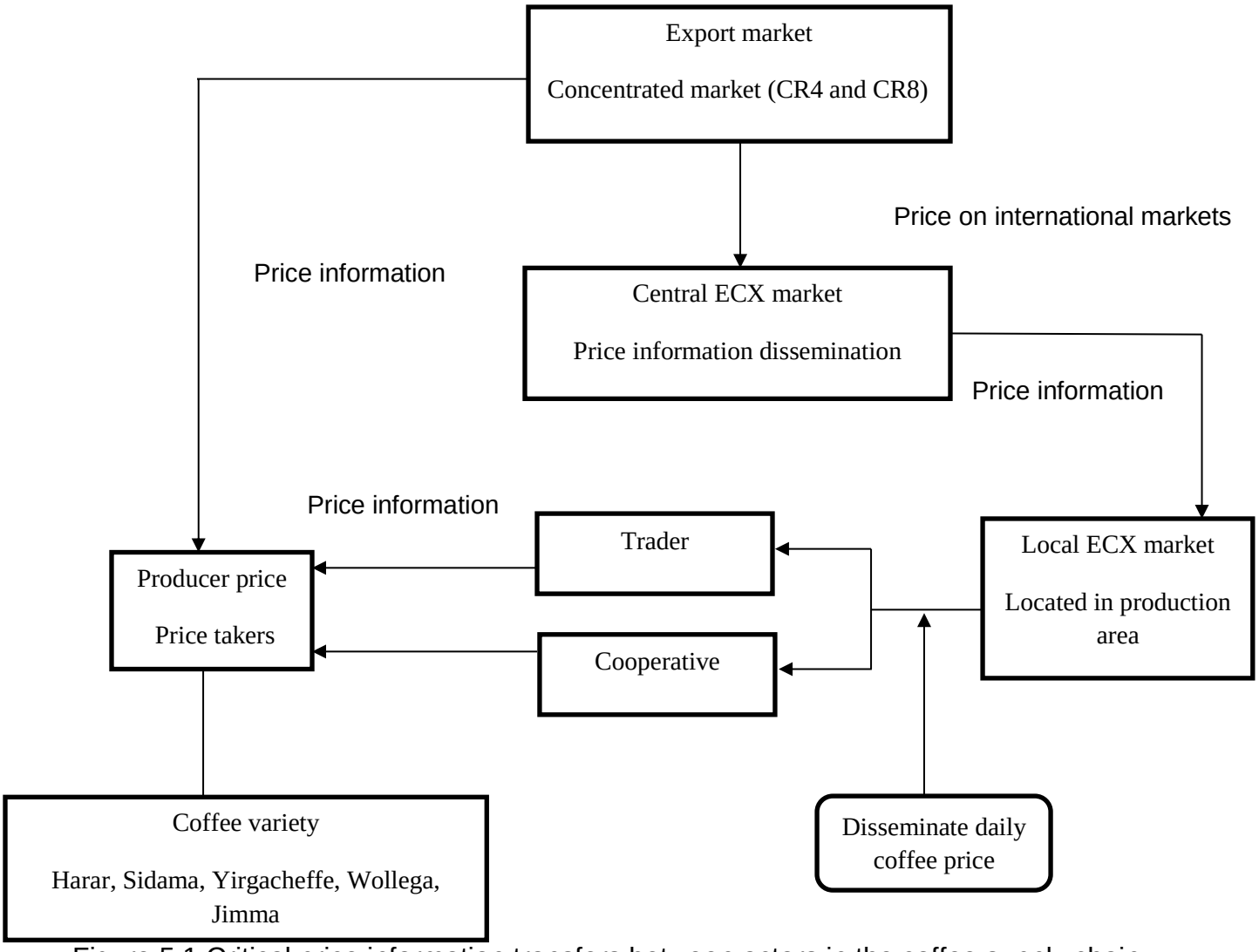


Figure 5.1 Critical price information transfers between actors in the coffee supply chain

Note: The arrows refer to price information transfers and not to physical flows of coffee or money

[10] A Market characterized by a small number of large buyers who control all purchases

The ECX plays a central role in controlling and directing the Ethiopian coffee market (Figure 5.1; see Chapter 2 for a more detailed review of the coffee chain). Furthermore, the local producer markets are organised under regional ECX markets in which coffee producers supply their coffee through cooperatives or traders. The prices offered in the ECX markets influence the price setting in the producer market. However, the ECX does not have the mandate to set export prices. Since the ECX follows the international coffee price for price setting, it most likely influences the price-setting strategy of the exporters.

The Ethiopian coffee production and different coffee markets are highly heterogeneous. Part of the heterogeneity emanates from the coffee varieties grown in the different regions of the country (see Chapter 2). Moreover, not only are there differences in the quality of the various coffee types, there are also differences in infrastructure. Some local producer markets barely receive any market information. Furthermore, while some markets are connected to all weather roads, other markets barely have access to any type of road. Therefore, unlike the regular commodity exchange, the ECX also has the responsibility of improving the basic market infrastructure at every level of the coffee market where problems result in weak price integration and transmission between the different market actors (Gabre-Madhin and Goggin, 2005). One particular area of interest is the flow of price information throughout the chain (Figure 5.1), and its impact on actual price transmission. Imperfect price integration and transmission results in a price reduction at the farm level that is only slowly, and possibly not fully, transmitted through the supply chain (Subrvie, 2011; Mofya-Mukuaa and Abdulai, 2013; Fousekis, 2015). However, price integration and transmission studies seldom take into account different types and qualities of coffee, while studies on quality (Otero and Milas, 2001; Ghoshray, 2009) argue that quality is important in price relationships. This chapter addresses this gap in the literature as it investigates market integration and price transmission for the five Ethiopian coffee types along the coffee value chain. Moreover, coffee is Ethiopia's most important agricultural export product, and the sector has been subject to frequent policy reform. For this chapter, we consider three different groups of actors in the chain together with their price relationships for the five coffee varieties. These three groups include the producer–ECX market, the producer-export market, and ECX-export markets.

5.2 Empirical Literature

Various studies have examined the market integration and price transmission between the domestic market and the international coffee markets. These studies either compared coffee-producing countries or focused on a country that had undergone a market reform. Fafchamps and Hill (2007), used cross-sectional data to examine the transmission of international coffee prices through the domestic value chain in Uganda. They found that producer price fluctuations were inconsistent with constant transaction costs, which they assumed to be the result of significant storage and contango marketing costs. They also found that the heightened price was due to the entry of new traders which increased search time for quality coffee. Their empirical tests rejected the storage and marketing costs explanation, but they did find some evidence of trader entry in response to a rise in export price.

Using an Error Correction Model, Xavier (2011) analysed the impact of policy reforms on the market integration between international and domestic coffee prices in Colombia, Ghana, and the Ivory Coast. The findings indicated that the reforms induced stronger relationships between domestic and international prices in Colombia, but not in Ghana nor in the Ivory Coast. The researcher explained that these differences between the countries arose as a result of different domestic institutional arrangements. Li and Saghaian (2013) also used an Error Correction Model to examine the price relationships between producer and world coffee prices for Colombian Milds and Vietnamese Robusta coffee, focusing on the long-run integration and short-run adjustments. They found evidence of long-run relationships between the world price and the grower price for both Colombian Milds and Vietnamese Robusta. Moreover, they found an asymmetric short-run price adjustment towards equilibrium for both types of coffee. In addition, their research results showed a slightly higher degree of market integration for Colombian Milds than for the Vietnamese Robusta coffee.

Furthermore, the impact of coffee sector reforms on the speed of transmission of price shocks in the producer prices was studied by Subervie (2011), using a Threshold Cointegration model. The study investigated the cases of El Salvador, Colombia, and India, and showed that producer and world prices were closely cointegrated after policy reforms, with an increased impact of monthly variations in world prices on producer price variations. The results also pointed to asymmetric price adjustments. The pre-reform period was favourable to producers, since, after the reform, the positive price adjustments were no longer transferred to the producer level, subsequently disadvantaging the producers. Moreover, there were only transmissions of

decreasing prices during a short period of time. Subervie (2011) also highlighted cases in which deviations resulting from reductions in world prices were eliminated relatively quickly in the post-reform period. The Threshold Autoregression Model, as applied by Mofya-Mukuka and Abdulai (2013) to examine the effects of market liberalisation on coffee price transmission from world prices to grower prices in Zambia and Tanzania, showed several structural breaks. The results confirmed that price transmission improved in the case of Zambia where coffee marketing was fully liberalised, although transmission was asymmetric. This implied that price reductions were affecting producers to a greater extent than price increases over an identified threshold. In comparison, the Tanzanian coffee marketing system was not completely liberalised. Negative shocks from the long-run price equilibrium receded faster before the reform, while positive shocks receded faster after the reform.

Amongst the studies on Ethiopian coffee market integration and price transmission, Worako et al. (2008) applied an Error Correction Model to test the impact of liberalisation on price transmission for Ethiopian coffee between 1993 and 2006. The findings indicated that market liberalisation induced a long-run relationship between prices at grower, wholesaler, and exporter levels. The estimation of the models showed that only short-run transmissions from prices on the world market to the domestic markets improved. In addition, the transmission has remained weak in the prices between producer-to-auction and auction-to-world markets. The researchers attributed this to the weak domestic institutional framework coordinating the coffee market. The study concluded by proposing that negative price changes were transmitted much faster than positive ones. Alemu and Worako (2009) applied a three-regime Threshold Vector Error Correction Model to estimate asymmetric transmissions in coffee prices between 1998 and 2006. Their results revealed a unidirectional transmission of shocks from the world price to auction price, and then to producer price. The results also indicated that producer prices were less responsive to changes in world prices (positive or negative) than auction prices. They suggested that the lower responsiveness could be attributed to the increased use of the domestic market as a major outlet by coffee suppliers at times of lower world prices.

Seyoum (2010) sought to explain the price transmission between the international, auction, and producer prices in the Ethiopian coffee market between 1991 and 2009 using a Vector Error Correction model. Similar to Worako et al. (2008), the study found a long-run cointegration between these three markets. The long-run analysis further showed an equivalent change in producer prices, following a change in the auction market. Furthermore, only half of

the changes from the international price were passed on to the auction and producer markets in the long run. The model results indicated that the producer and the international markets were poorly integrated and had very weak relationships to one another as compared to the auction and the international market. The researcher linked the weak relationship to the lack of market infrastructure, information asymmetry, and poor transportation systems. More recently, Hernandez et al. (2015) aimed to investigate whether the ECX has had an impact on the international-domestic coffee price relationships. Using Multivariate Generalised Autoregressive Conditional Heteroscedasticity (MGARCH), Dynamic Conditional Correlation (DCC), and Baba-Engle-Kraft-Kroner (BEKK) models, the researchers concluded that the ECX has had only limited success in terms of having a positive impact on price dynamics.

The present study expands on the aforementioned literature through two contributions. Firstly, the study aims to investigate market integration and price transmission along the coffee value chain for the five types of Ethiopian coffee. All previously mentioned studies (Worako et al. 2008; Alemu and Worako, 2009; Seyoum, 2010), except for Hernandez et al. (2015), have examined price transmission against the impact of the 1990's market reform. However, as far as can be detected, no previous research has comprehensively studied the integration of and price transmission for the different Ethiopian coffees by taking the establishment of the ECX as a point of reference. Secondly, the present study is the first of its kind to implement the Nonlinear Autoregressive Distributed Lag model (NARDL), as recently developed by Shin et al. (2014), in studying price symmetry in African agriculture and food markets. The model has the advantage of examining both nonlinearity and asymmetry simultaneously in the short- and long-run.

5.3 Data Sources and Econometric Methods

5.3.1 Data and sources

The data used for the study consisted of the average monthly coffee producer price series for the period December 2008 to May 2013. The period between December 2008 and March 2015 was considered for ECX and export coffee prices. The price data for producers were collected from the Central Statistical Agency (CSA) through the monthly Ethiopian Rural Agricultural Price Survey reports (also used in chapter 4). The monthly ECX coffee prices were collected from the Ethiopian Commodity Exchange headquarters in Addis Ababa, while the export coffee prices were gathered from the Ethiopian customs office (also used in chapter 3). Furthermore, the monthly exchange rate was obtained from the National Bank of Ethiopia (NBE). For this study,

the price data collected from the producer markets located in the different regions of the country were taken as the producer price. The price data collected from the traders selling their coffee at the ECX were considered as the ECX price. In addition, the export price is the price received by the exporters (traders) after selling their coffee. For all three price types, the researcher collected the data in accordance with the type of coffee, which adds an extra dimension for further analysis. Finally, the study attempted to collect long-run data for cooperative prices for the different types of Ethiopian coffees. The data was solicited from the Oromia cooperative union, however, only data for the period of January 2012 to August 2012 was made available by the cooperative union. Thus, due to the lack of adequate data, the study made comparisons between the cooperative and conventional coffee markets for that period only.

All price data were converted into USD per pound (USD/lb), which serves as a standard unit of price measurement in the international commodity markets. The USD per kg unit of price measurement is used in the figures to follow in order to aid interpretation. The official monthly average exchange rate was used to convert producer, ECX, and export prices that were documented in the local currency (Birr). Finally, all price series were indexed taking the period December 2008 as a base.

The major coffee types considered for this study were Wollega, Sidama, Yirgacheffe, Jimma, and Harar (Figure 5.1). As also explained in the previous chapters, coffees produced in the different regions in Ethiopia are characterised by vast differences in quality amongst the production areas. The majority of coffee-producing areas are located in the Southern, Southwestern, and Eastern highlands of Ethiopia. Harar coffee, which comes from Eastern Ethiopia, is the premium type out of the five coffees considered in this study and thus, it fetches the highest price in both the domestic and export markets. Yirgacheffe and Sidama coffees, which are produced in the south of Ethiopia, are the second-best quality and brand coffees. Jimma and Wollega, which are relatively low quality coffees, are located close to each other in the south-western part of Ethiopia. However, Wollega coffee is said to be superior to Jimma coffee.

Kufa (2012) distinguishes between the origins and tastes of the different types of coffee in the following way: spicy for Sidama, fruity for Wollega, floral for Yirgacheffe, winey for Jimma, and mocha for Harar. All coffees coming from Harar are unwashed, which is a typical production method for dry environments. Despite these quality differences, all coffees produced in the country are quite homogenous and are perfectly substitutable (Worako et al., 2008).

The price evolution of Ethiopian coffee types between (i) producer and ECX price, (ii) producer and export price, and (iii) ECX and export price are displayed in Figures 5.2, 5.3, and 5.4, respectively. In the producer-ECX price graph, all the producer prices seem to follow the same price movements, except for Harar, which follows its own pattern and fetches a higher price than the other coffee types. In the ECX market, prices for all types of coffee followed a similar price pattern until mid-2011. Early in 2011, the coffee price in the international market increased dramatically for various reasons, including a coffee shortage and increases in commodity prices. From mid-2011 onwards, the price trend for Harar coffee started to diverge from the trends for the other coffee types and followed a distinct pathway. Producer and ECX price series seem to respond in a similar way to distinct market shocks, except for Harar coffee.

In the producer-export price series (Figure 5.2), the export market prices appear to be especially volatile and the 2011 price hike lasted for a longer time while the effect on the producer price was not as great. Likewise, the ECX-export price (Figure 5.4) portrays a similar pattern.

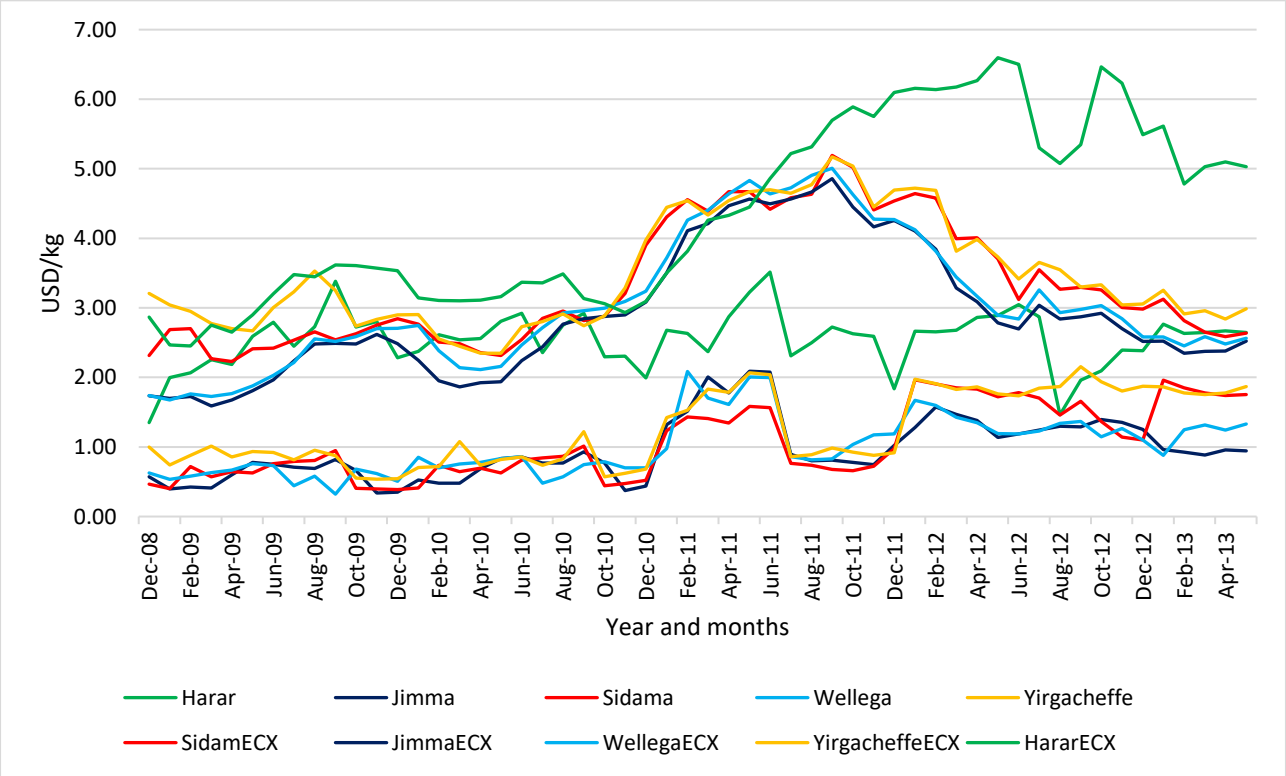


Figure 5.2 Price evolution of Ethiopian coffee types between producer and ECX price (in USD/kg)

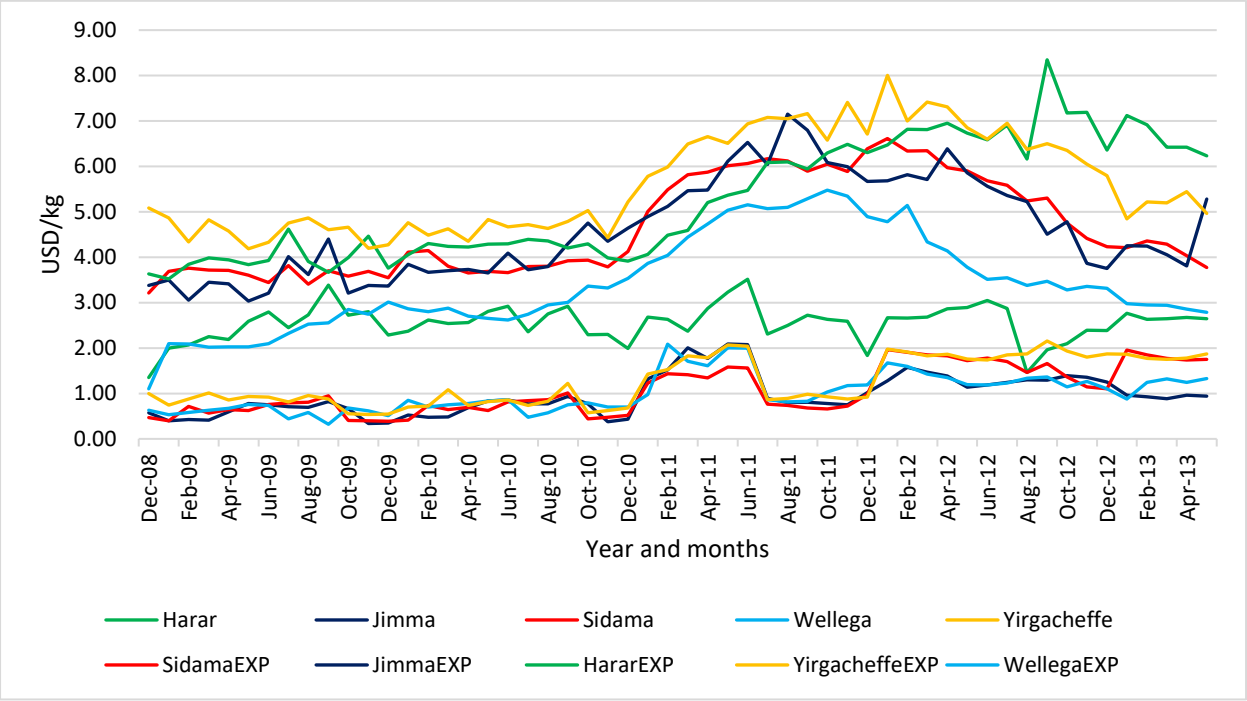


Figure 5.3 Price evolution of Ethiopian coffee types between producer and export price (in USD/kg)

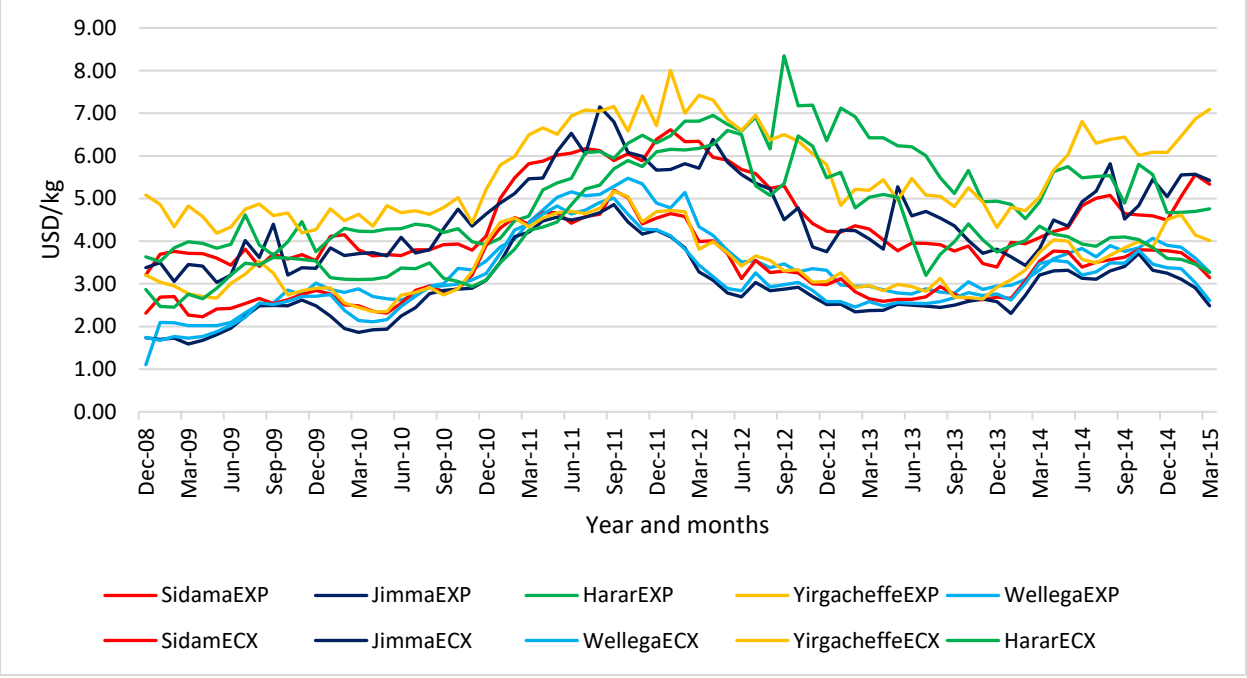


Figure 5.4 Price evolution of Ethiopian coffee types between ECX and export price (in USD/kg)

5.3.2 Econometric analysis: Nonlinear Autoregressive Distributed Lag model (NARDL)

This study applies a Nonlinear Autoregressive Distributed Lag model (NARDL), the asymmetric continuation of the ARDL model, recently developed by Shin et al. (2014). The novelty of this technique is its ability to detect both short- and long-run asymmetries between price series using positive and negative partial sum decomposition. Moreover, the asymmetric ARDL specification allows the analysis of non-stationarity and nonlinearity jointly in the context of an unrestricted error correction model (e.g. see Katrakilidis and Trachanas (2012) and Atil et al. (2014). A detailed explanation of this model is given in chapter 3 (see section 3.4.3).

In addition, the present study tested the statistical relevance of a downward power relationship (the bargaining power goes downwards from exporter to ECX trader, then to producer) along the Ethiopian coffee value chain within three NARDL models, namely, exporter to producer, exporter to ECX, and ECX to producer. As proposed by Shin et al. (2014), the NARDL model specification is written as follows:

Changes in ECX price (*pex_t*) to changes in the producer price (*pp_t*)

$$\Delta pp_t = \sigma_0 + h_1 pp_{t-1} + h_2{}^{+} pex_{t-1}^{+} + h_3{}^{-} pex_{t-1}^{-} + \sum_{j=1}^{u-1} \forall_j \Delta pp_{t-j} + \sum_{j=0}^{v-1} \mu_j^{+} \Delta pex_{t-j}^{+} + \sum_{j=0}^{v-1} \mu_j^{-} \Delta pex_{t-j}^{-} + \mu_t \quad \text{Eq. 1}$$

Change in Export price (*pE_t*) to changes in the producer price (*pp_t*)

$$\Delta pp_t = \sigma_0 + h_1 pp_{t-1} + h_2{}^{+} pE_{t-1}^{+} + h_3{}^{-} pE_{t-1}^{-} + \sum_{j=1}^{u-1} \forall_j \Delta pp_{t-j} + \sum_{j=0}^{v-1} \mu_j^{+} \Delta pE_{t-j}^{+} + \sum_{j=0}^{v-1} \mu_j^{-} \Delta pE_{t-j}^{-} + \mu_t \quad \text{Eq. 2}$$

Changes in Export price (*pE_t*) to changes in the ECX price (*pex_t*)

$$\Delta pex_t = \sigma_0 + h_1 pex_{t-1} + h_2{}^{+} pE_{t-1}^{+} + h_3{}^{-} pE_{t-1}^{-} + \sum_{j=1}^{u-1} \forall_j \Delta pex_{t-j} + \sum_{j=0}^{v-1} \mu_j^{+} \Delta pE_{t-j}^{+} + \sum_{j=0}^{v-1} \mu_j^{-} \Delta pE_{t-j}^{-} + \mu_t \quad \text{Eq. 3}$$

Where, pE_t, pex_t, pp_t, denote the export, ECX, and producer prices; pE_{t-1}^{+}, pE_{t-1}^{-}, pex_{t-1}^{+}, pex_{t-1}^{-} represents the partial sums of positive and negative changes in export and ECX prices; u, and v are lag orders; $h_2 = \frac{-h_1}{\partial^{+}}$, $h_3 = \frac{-h_1}{\partial^{-}}$ are the long-run impacts of price increases and reductions between the pairs of market prices; and h_1 represents the price elasticity. The short-run adjustment to positive and negative in one of the pair prices is denoted by μ_j^{+} and μ_j^{-} ; σ_0 is the constant.

Following Greenwood-Nimmo et al. (2013), equations 1, 2, and 3 are also re-estimated by imposing short-run symmetry. Such restrictions improve the estimation of the long-run price dynamics. The modified equations are as follows (Greenwood-Nimmo et al., 2013):

$$\Delta pp_t = \sigma_0 + h_1 pp_{t-1} + h_2{}^{+} pex_{t-1}^{+} + h_3{}^{-} pex_{t-1}^{-} + \sum_{j=1}^{u-1} \forall_j \Delta pp_{t-j} + \sum_{j=0}^{v-1} \mu_j \Delta pex_{t-j} + \mu_t \qquad \text{Eq. 4}$$

$$\Delta pp_t = \sigma_0 + h_1 pp_{t-1} + h_2{}^{+} pE_{t-1}^{+} + h_3{}^{-} pE_{t-1}^{-} + \sum_{j=1}^{u-1} \forall_j \Delta pp_{t-j} + \sum_{j=0}^{v-1} \mu_j \Delta pE_{t-j} + \mu_t \qquad \text{Eq. 5}$$

$$\Delta pex_t = \sigma_0 + h_1 pex_{t-1} + h_2{}^{+} pE_{t-1}^{+} + h_3{}^{-} pE_{t-1}^{-} + \sum_{j=1}^{u-1} \forall_j \Delta pex_{t-j} + \sum_{j=0}^{v-1} \mu_j \Delta pE_{t-j} + \mu_t \qquad \text{Eq. 6}$$

This study attempts to test market integration and price transmission for five types of Ethiopian coffee along the market chain through three steps. Firstly, the Shin et al. NARDL approach is used to test cointegration along the market chain. Secondly, the study investigates the existence of price asymmetry for the different types of coffee. Thirdly, following the asymmetric test, the extent of a short- and long-run asymmetric price change is tested.

In addition, the robustness of the NARDL model was tested using two common tools as diagnosis tests. These included the Breusch-Godfrey Lagrange Multiplier test for serial correlation, and the Autoregressive Conditional Heteroscedasticity (ARCH) test for heteroscedasticity, as developed by Engle (1982). These tests are performed on the residuals of the estimated variables. The subsequent results are presented in the following section.

5.4 Results and discussion

5.4.1 Stationary analysis

Before proceeding with the NARDL bounds tests, we had to ensure that none of the variables under consideration were integrated to an order higher than one. In such an order of integration (I(2) or higher), the computed statistics provided by Pesaran et al. (2001) and Narayan (2005) are not valid (Ang, 2007). In the presence of I(2) variables, the joint computed F-statistics would not be valid.

Table 5.1 shows the Augmented Dickey-Fuller (ADF) test results for price series after the establishment of the ECX. The unit root test was performed at level and at first difference with the intercept, and with the intercept and trend term. The optimum lag was selected by using the

Akaike information criterion (AIC). Based on the critical values reported, only the Harar producer price appeared to be stationary at the level, while all other price series became stationary after the first difference. Table 5.1 also shows that none of the series have an integration order of I(2) or higher, which satisfies the precondition to undertake a cointegration analysis using ARDL.

Table 5.1 Unit root test of producer, ECX and export prices of Ethiopian coffee

Coffee type	At level/ First difference	Producer price		Order of integration	ECX price		Order of integration	Export price		Order of integration
		τ_c	$\tau_{c,t}$		τ_c	$\tau_{c,t}$		τ_c	$\tau_{c,t}$	
Harar	At level	-4.83***	-4.84***	I(0)	-1.48	-1.09	I(1)	-1.58	-1.0	I(1)
	First difference	-	-		-7.16***	-7.33***		-12.75***	-12.88***	
Yirgacheffe	At level	-2.0	-3.4*	I(1)	-1.48	-1.62	I(1)	-1.25	-1.46	I(1)
	First difference	-7.86***	-7.79***		-7.57***	-7.52***		-14.13***	-13.97***	
Sidama	At level	-2.1	-3.4*	I(1)	-1.66	-1.44	I(1)	-1.26	-1.32	I(1)
	First difference	-7.28***	-7.21***		-7.20***	-7.19***		-8.18***	-8.11***	
Wollega	At level	-2.53	-3.4*	I(1)	-2.13	-1.83	I(1)	-2.02	-1.83	I(1)
	First difference	-7.8***	-7.73***		-5.68***	-5.86***		-2.84***	-15.32***	
Jimma	At level	-2.30	-3.3*	I(1)	-2.08	-1.82	I(1)	-1.64	-1.69	I(1)
	First difference	-6.3***	-6.24***		-5.57***	-5.69***		-11.99***	-11.9***	

Note: ***, * indicate statistical significance at 1% and 10% respectively

5.4.2 Coffee market channel

As previously mentioned, coffee is marketed through two alternative channels (Figure 2.2). Most the coffee trade takes place through a conventional coffee channel, which consist of collectors, traders, and exporters. Only a small share of the coffee is traded through the cooperative channel, which encompasses primary cooperatives and unions that collect coffee from their member farmers.

Figures 5.5 and 5.6 compare the price evolutions in the cooperative and conventional coffee markets between January 2012 and August 2012. The evolution of the coffee prices for the producer, cooperative, ECX, and export chains were computed for each type of coffee. Results suggest that the cooperative channel earns a higher export price. The availability of alternative niche markets (for example, fair trade and organic markets) allows cooperatives to take advantage of a price premium. A comparison of the ECX price and cooperative prices shows mixed results for the different types of coffee with neither the ECX nor the cooperative price fetching consistently higher prices.

Furthermore, price gaps between producer-ECX and producer-cooperative are similar for all of the coffee types. Regardless of the coffee type, the coffee price at the ECX level is double that of the producer price. Turning to the price patterns between producer and export prices, the export price received by the union in the cooperative channel is much higher than the producer price. This particular price gap is observed for all the coffee types and is larger for premium coffee types such as Harar and Yirgacheffe. Moreover, the same pattern is observed in the conventional coffee market, but the gap is not as large as with the cooperative channel. This pattern was also observed by Minten et al. (2014), who investigated the impact of the management change with the establishment of the ECX on the promotion of quality premiums. They found that after the introduction of the ECX, the price premiums for the cooperatives, as compared to traders, increased by 9%.

Harar coffee is the premium coffee out of the five coffees considered in this study and it fetches the highest price in both the domestic and export markets. The second-best quality coffee is Yirgacheffe coffee, which sometimes exceeds the quality expectations of the Harar coffee in the international market. Interestingly, in the cooperative market channel, Yirgacheffe coffee fetches a higher price than Harar coffee. Minten et al. (2014) relates the higher coffee price to options for coffee certification which are more relevant for Yirgacheffe coffee. As previously discussed in chapter 2, much of the Harar coffee is exported to the Saudi market.

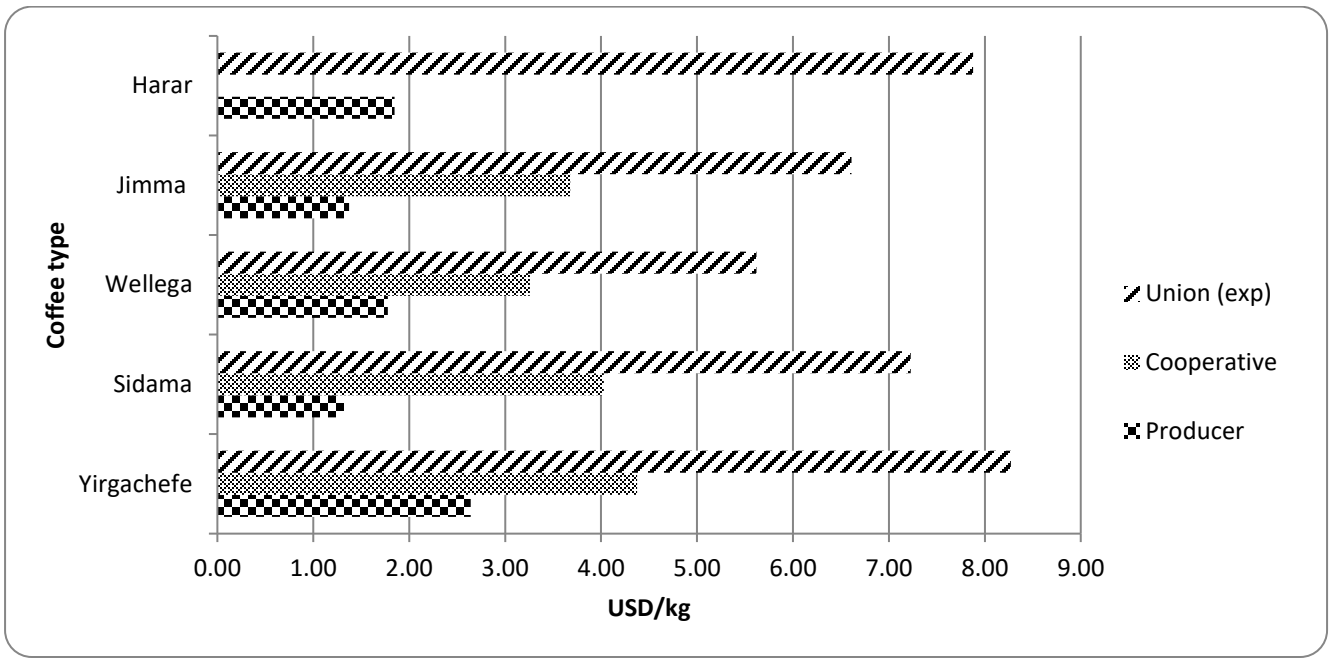


Figure 5.5 Average producer, cooperative, and cooperative union prices (USD/kg)

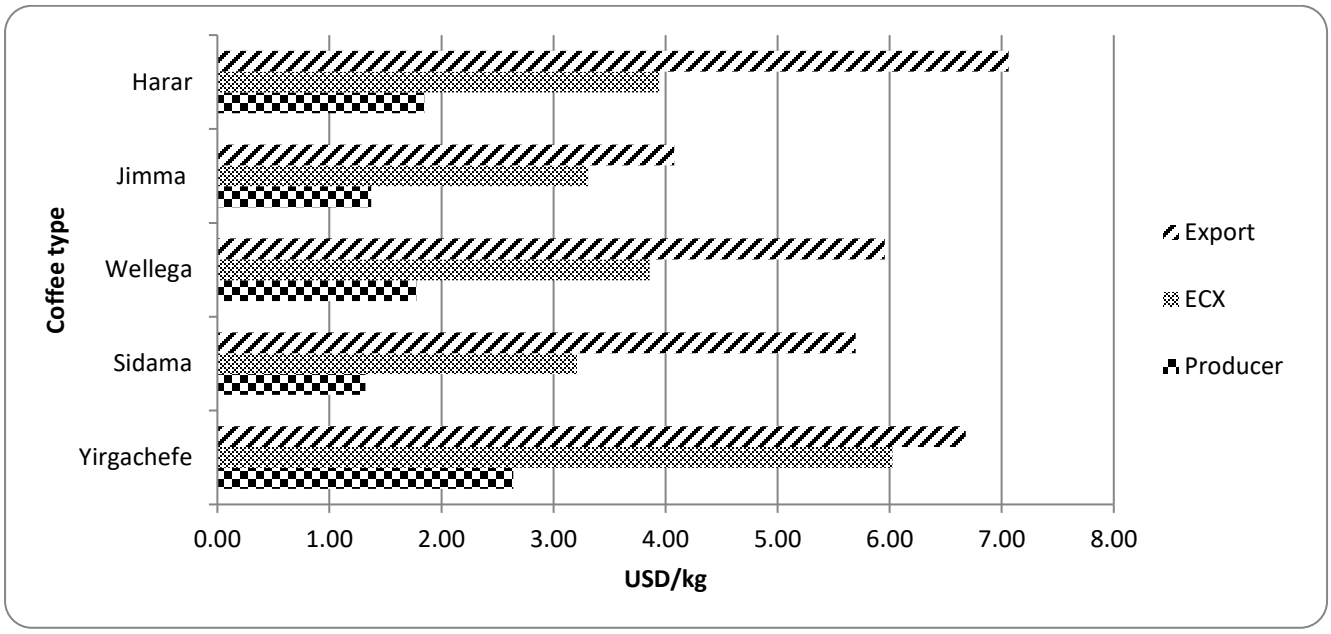


Figure 5.6 Average producer, ECX, and export coffee prices (USD/kg)

To understand the vast price gap between export-ECX and export-producer prices, one needs to understand the costs incurred by the producers, traders, and exporters in the Ethiopian coffee value chain. In a USAID (2010) study in 2008, the estimated average cost at the farm gate was 1.06 USD per kg, whereas the average farm gate price per kg of green coffee was 2.16 USD. The cost of collecting and processing by traders was estimated at 0.33 USD per kg,

and they charged a margin of 0.386 USD per kg. The export cost for the traders (exporters) was calculated at 0.58 USD per kg, with an exporters' margin of 0.49 USD. In addition to the long and costly value chain, the productivity of the Ethiopian coffee industry is rather low, with rather high production costs (Van Der Vossen, 2005). The average Ethiopian coffee yield is 300kg/ ha, which is equal to a third of Colombia's yield (900kg/ ha), half of El Salvador's yield, and a quarter of Costa Rica's and Brazil's yields of 1.2MT/ ha and 2MT/ ha, respectively (Van Der Vossen, 2005; MARO et al., 2014). Worako et al. (2014) included cost items in their study that had been ignored by previous studies, such as impurity and weight losses during cleaning. The study calculated the average value chain cost of the farm gate-ECX and ECX-export and found that 0.42 USD per kg was incurred by the trader (farm gate-ECX), while 0.46 USD per kg was incurred by the exporter.

5.4.3 NARDL bounds tests for cointegration

Model (1) represents the price transmission from the ECX to the producer, while model (2) portrays the price transmission between exporter and producer. Furthermore, model (3) portrays the price transmission between exporter and the ECX. A general-to-specific approach was used to determine the lag order (Shin et al., 2014). For each of the three models (table 5.2), a maximum lag order of 4 was set as a starting point for iteration and dropping insignificant regressors.

The results displayed in Table 5.2 confirm that the producer and ECX markets have established a significant level of cointegration. The continuous adjustment of the producer price with the ECX price was expected from the establishment of the ECX, since it aimed to create transparency in the Ethiopian commodity market. The establishment of a long-run cointegration between the prices on the producer and export markets for all coffee types also suggests that market information is accessible at producer level. Similarly, the results of the model testing the integration between Export and ECX prices, suggest that prices are integrated in the long run. Thus, the ECX does not have to follow the international coffee price when setting a price. Rather, it sets a range of prices for a trader to make a bidding. The price setting takes the previous day's price as a reference point to protect traders from incurring a loss while exporting the coffee.

Table 5.2 Tests for cointegration using the NARDL approach

Price pairs	ECX – Producer	Export - Producer	Export - ECX
	NARDL model (1) with LR and SR asymmetry F_{PSS}	NARDL model (2) with LR and SR asymmetry F_{PSS}	NARDL model (3) with LR and SR asymmetry F_{PSS}
Harar	16.07***	11.46***	12.19***
Jimma	9.73***	15.72***	74.98***
Sidama	9.50**	23.58***	13.54***
Wollega	38.06***	19.7***	17.21***
Yirgacheffe	34.8***	33.9***	26.9***

Notes: ***, ** indicate statistical significance at 1% and 5% respectively. By taking a maximum lag of 4, a general to specific approach is used to reach the optimal lag length.

5.4.4 Asymmetric price transmission

Table 5.3 displays the results of the symmetry tests for producer-ECX, producer-export, and ECX-export prices as presented in equations 1, 2, and 3. The long-run test results fail to reject the null hypothesis of symmetry between producer and ECX price changes for all types of coffee. This implies that the prices of the different coffee types were transmitted symmetrically between producers to the ECX in the long-run. The Wald test for the short-run symmetric test was only significant for the prices of Harar coffee. Harar coffee showed both positive (SP+ = 1.21) and negative (SP- = 0.94) price transmission between producer and ECX prices (Table 5.4). In addition, the price transmission was larger for positive price changes than for negative changes. Such positive cumulative effects are fortunate for Harar coffee producers, even though they only last for a short time. The short-run price transmission for both Jimma (S_{P^-} = 1.58) and Sidama (S_{P^-} = 7.11) was detected only from the negative component. The coefficients indicate that a negative change in export price of 1%, resulted in a decrease of 1.58% and 7.11% in producer price of Jimma and Sidama coffee, respectively. The change in the price of Sidama coffee might appear relatively large, however, the effect in absolute value is rather small due to the low price that producers receive. As such, price changes are more sensitive when the changes occur at higher levels of the market.

Furthermore, the results of the Wald test rejected the null hypothesis of long-run price symmetry between producer-exporters for the price of Harar, Sidama, and Yirgacheffe coffees. The results also show an interesting interaction between the positive and negative price changes for the three types of coffee (Table 5.4). The Harar coffee price showed a significant transmission of negative price changes (Lp- = 0.43) between export and producer prices in the long-run, which suggests that only price decreases are transmitted in the long-run. Price transmission between export and producer prices for Yirgacheffe coffee were significant for both positive and negative price changes (Lp+ = 0.90, Lp- = 1.37). The magnitude of the negative price change is larger than that of positive price changes, which is unfavourable for Yirgacheffe coffee producers. The only type of coffee for which a positive price change transmission was found between export and producer prices in the long-run was Sidama coffee (Lp+ = 5.98). The common characteristic of the coffees (Harar, Sidama, and Yirgacheffe) that show a long-run price asymmetry between export and producer prices is that they are coffees that are better known for their quality and that are branded. The Wald test for the short-run symmetric test also revealed a significant transmission for the prices of Jimma and Sidama coffee.

Therefore, the long-run test results fail to reject the null hypothesis of symmetry between Exporter and ECX price changes for all five types of coffee. However, a negative price transmission between export and ECX prices for Harar coffee was found in the short-run (S_{P^-} =0.22. Moreover, a decrease of 1% in the export price for Harar coffee lowers the price on the ECX by 0.22%. Although the effect is small, it is to the disadvantage of the traders in the ECX market as only negative price changes are transmitted. Furthermore, evidence of short-run asymmetric price transmission for the prices of Jimma and Sidama coffees was not found.

Table 5.3 Long run and short run asymmetry test

Price pair		Producer – ECX		Producer- Export		ECX-Export	
		NARDL model (eq. 6) with LR and SR asymmetry	NARDL model (eq. 9) with restricted SR	NARDL model (eq. 7) with LR and SR asymmetry	NARDL model (eq. 10) with restricted SR	NARDL model (eq.8) with LR and SR asymmetry	NARDL model (eq.11) with restricted SR
Harar	W_{LR}	-0.34 (0.45)	0.16 (0.77)	0.69 (0.04)	0.69 (0.04)	-0.003 (0.98)	-0.25 (0.30)
	W_{SR}	2.15 (0.01)		-		0.22 (0.04)	
Jimma	W_{LR}	1.76 (0.49)	1.76 (0.49)	0.84 (0.50)	-0.32 (0.77)	-0.31 (0.24)	-0.32 (0.22)
	W_{SR}	-		1.58 (0.00)		-	
Sidama	W_{LR}	0.41 (0.81)	0.41 (0.81)	6.60 (0.00)	2.39 (0.13)	-0.30 (0.54)	0.08 (0.86)
	W_{SR}	-		5.43 (0.00)		0.26 (0.31)	
Wollega	W_{LR}	1.43 (0.36)	1.43 (0.36)	0.66 (0.58)	0.66 (0.58)	-0.55 (0.22)	-0.61 (0.26)
	W_{SR}	-		-		-	
Yirgacheffe	W_{LR}	-0.052 (0.96)	-0.05 (0.96)	2.28 (0.02)	2.28 (0.02)	-0.009 (0.97)	-3.44 (0.67)
	W_{SR}	-		-		-	

Notes: W_{LR} denotes the Wald test for long run symmetry defined by $-h_2^+ / h_1 = -h_3^- / h_1$; W_{SR} denotes the Wald test for short run symmetry defined by $\sum_{j=0}^{v} \mu_j^+ = \sum_{j=0}^{v} \mu_j^-$; ( ) represents the p-values.

Table 5.4 The long run and short run positive and negative price coefficients

Price pair	Type of relationship	Producer - ECX		Producer- Export		ECX-Export	
		Coefficient	Prob.	Coefficient	Prob.	Coefficient	Prob.
Harar	L_P+	-	-	0.26	0.23	0.09	0.59
	L_P-	-	-	-0.43	0.03	0.09	0.53
	S_P+	1.21	0.02			-	-
	S_P-	0.94	0.04			0.22	0.04
Jimma	L_P+	1.86	0.23	1.42	0.12	-0.27	0.13
	L_P-	0.092	0.94	0.58	0.33	0.04	0.75
	S_P+			-	-	-	-
	S_P-			1.58	0.00	-	-
Sidama	L_P+	0.90	0.35	5.98	0.00	0.079	0.76
	L_P-	0.48	0.63	-0.62	0.52	0.37	0.25
	S_P+	-	-	-	-	1.19	0.00
	S_P-	-	-	7.11	0.00	0.91	0.00
Wollega	L_P+	0.64	0.53	0.60	0.55	-0.36	0.33
	L_P-	-0.79	0.35	-0.062	0.87	0.19	0.21
	S_P+	-	-	-	-	--	-
	S_P-	-	-	-	-	-	-
Yirgacheffe	L_P+	0.39	0.58	0.90	0.07	0.15	0.35
	L_P-	0.44	0.58	-1.37	0.02	0.16	0.39
	S_P+	-	-	-	-	-	-
	S_P-	-	-	-	-	-	-

Note: L_P+, L_P- , S_P+, and S_P^- indicate the positive and negative long-run and short run coefficients, respectively.

5.5 Robustness tests

Table 5.5 presents the results of serial correlation and autoregressive conditional heteroscedasticity tests as robustness checks. In all cases, the LM statistics were insignificant and therefore, no evidence of autocorrelation problems was found. The ARCH test was performed at the 5% confidence level and the results revealed that all price series are free from heteroscedasticity. Appendix II shows the results of the stability tests performed using the cumulative sum (CUSUM) test. Thus, the diagnostic results show that the above estimation results are free from model specification errors and are stable.

Table 5.5 Diagnostic tests: LM and ARCH tests for serial correlation and autoregressive conditional heteroscedasticity

		Producer- ECX	Producer-export	ECX-export
Harar	LM	4.89 (0.08)	4.22 (0.12)	1.28 (0.52)
	ARCH	21.30 (0.67)	4.50 (0.80)	30.18 (0.26)
Jimma	LM	1.62 (0.44)	1.09 (0.57)	0.61 (0.73)
	ARCH	2.78 (0.94)	16.15 (0.24)	1.80 (0.98)
Sidama	LM	0.004 (0.99)	1.26 (0.53)	0.97 (0.61)
	ARCH	6.00 (0.64)	0.94 (0.33)	9.07 (0.33)
Wollega	LM	1.47 (0.47)	1.18 (0.55)	0.17 (0.91)
	ARCH	0.001 (0.97)	3.32 (0.91)	9.77 (0.28)
Yirgacheffe	LM	0.66 (0.71)	1.83 (0.39)	0.89 (0.63)
	ARCH	4.57 (0.80)	0.43 (0.50)	11.11 (0.19)

5.6 Conclusions

The link between market policy reforms and price transmission has been at the centre of debate within the commodity marketing literature due to its economic and welfare implications. Ethiopia, like other developing countries, relies heavily on a limited number of primary commodities, which makes policy interventions in these markets very sensitive to welfare effects. More specifically, the Ethiopian coffee sector, which accounts for the lion's share of the country’s exports, is a source of livelihood for more than 15% of the population. As the coffee sector is based on a long value chain, any policy implemented within the sector will have major repercussions.

Thus, the objective of this study has been to empirically investigate the market integration and price transmission symmetry for the five major types of Ethiopian coffee along the coffee value chain after the implementation of the ECX. The ECX aimed to establish an institutionalised Ethiopian coffee market. The introduction of the ECX was intended to overcome the major constraints observed in the coffee market, such as lack of adequate market information, lack of integration, lack of transparency, high marketing and transaction costs, lack of trust between buyers and sellers, collusion, and dominance of exporters. This study applied nonlinear autoregressive distributed lag models to capture the asymmetric responses in the prices at producer level from price changes at the ECX and export level, as well as the prices at the ECX level from price changes at the export level. Using monthly price data for the period 2008-2013, responses to both negative and positive price changes, as well as in the short- and long-run, were considered.

The results suggest that the prices of different coffee types are integrated between producers and the export and ECX level, and between the ECX and the export level. Furthermore, the results showed a symmetric price transmission between producer and ECX, except for Harar coffee, for which evidence of short-run price asymmetry was found. The models of price transmission between producer and exporter prices further suggest the presence of both asymmetric and symmetric price transmission in the long- and short-run for Harar, Sidama, and Yirgacheffe coffee. The current results also indicate that the magnitude with which negative price changes between exporter and producer were transmitted is greater than that of positive price changes. Notably, the presence of price asymmetry for quality and branded Ethiopian coffees (Harar, Sidama, and Yirgacheffe) between the producer-exporter suggests that the number of traders for quality is lower leading to a higher risk of concentrated market power. Another important finding is the lack of asymmetric price relationships between the ECX and export markets for all types of Ethiopian coffee, except Harar coffee, for which a negative price transmission was found.

In general, there are various reasons for why exporters are more powerful in the Ethiopian coffee value chain. A first factor could be the increased market power of the existing coffee exporters. While the ECX increased competition at the level of the export, a World Bank (2014) study revealed that the largest exporters (selling more than 5 million USD per annum) carry out nearly 80% of coffee exports. The study further criticised that new exporters entering the market seem to face difficulties in terms of establishing trade, understanding the coffee markets, and accessing credit. These entry barriers allow existing exporters to collude and to create an oligopsonistic market. Secondly, the asymmetric price

transmission coming from the exporter to the producer market could indicate a higher adjustment cost incurred by the exporters. When exporters have limited time to meet the import requests, they make adjustments at the expense of the producers.

Overall, the results suggest that exporters enjoy an absolute advantage over the coffee producers who experience a reduction in the price they receive when market prices go down, yet they do not receive a higher price when the market prices go up. The current results also highlight the limited capability of the ECX in achieving the goals it had set for creating an integrated and transparent market along the Ethiopian coffee value chain. However, considering the length of time that the ECX has been operating in the Ethiopian coffee market, and the disorganised and uncoordinated Ethiopian coffee market prior to the establishment of the ECX, it may be too early to conclude that the institutionalisation process is a failure. Policy measures aimed at empowering the coffee producers, and at the same time creating a competitive market both at ECX and export level, could further contribute towards an integrated and transparent coffee market in Ethiopia.

Improving the effectiveness of a commodity exchange remains a challenge in a dysfunctional producers' and traders' market. Improvements may be needed for better knowledge on quality and grading at the producer level. Since the number of traders and cooperatives operating at the producer level are few in number, establishing grading and inspection centres at the farm gate level would encourage producers to know the quality of the coffee that they supply and to use this information when bargaining with the traders. Establishing such grading labs have been shown to have successful results in cooperatives supported by USAID in southern Ethiopia.

Furthermore, lowering the entry barriers to members at ECX could also improve transparency in the market. The high price to be paid for a membership seat in ECX is serving as a filtering mechanism for creating financially strong exporters which paves the way for collusion. Again, increasing the number of the exporters by itself does not guarantee the competitiveness of the export market. Therefore, ECX needs to set up an effective pricing scheme as a means for considering the capacity of the different exporters.

Chapter 6

De-commoditising Ethiopian coffees after the establishment of the ECX: An empirical investigation of smallholder coffee producers in Ethiopia

Abstract

The repercussions of reforming an agricultural market are mainly observed at the most vulnerable segment of the value chain, namely, the producers. In the current commodity market created with trade through the ECX, coffee is less traceable to its producers. Only cooperatives that sell certified coffee through the unions they belong to, are allowed to bypass the more commodified ECX market. This study aims to investigate if small-scale coffee producers in Southwestern Ethiopia that sell coffee through the certified cooperative are better off. It is assumed that the coffee sales through, and membership of, a cooperative, allows farmers to improve their coffee production as well as to improve other aspects of their livelihood. A sustainable livelihood approach was used as the inspiration for the welfare indicators that needed to be considered, data collected amongst members and non-members of certified cooperatives, and a propensity score model to investigate the impact of cooperative membership on the livelihood indicators. Results suggest that members of certified cooperatives indeed receive, on average, better prices. Yet, no evidence was found that indicates that the higher price is translated into better household income. Furthermore, coffee plantation productivity of those members who were interviewed was lower than that of the non-members. This finding could explain the failure to find an overall effect.

Keywords: Commoditization, Cooperative membership, Certification, Propensity score matching

Based on: Demise, T., D'Haese, M. Does de-commoditization matters for Ethiopian coffee producers: An empirical investigation smallholder coffee producers in Ethiopia (Under review)

6.1 Introduction

As part of a policy to revitalise the agricultural sector, and the coffee sector in particular, the Ethiopian government abolished its national auction in 2008 and established the Ethiopia Commodity Exchange (ECX) (FDRE Proclamation no. 602/2008 and Marketing Proclamation and its Directives 159/2009 and 161/2009). The ECX was intended to function as an organised marketplace, where buyers and sellers could meet to trade, while being assured of quality, quantity, payment, and delivery. This contributes towards more efficient and transparent market operations (ECX, 2008). Some commodities, such as oil seeds and pulses, benefit from the homogenisation of trade. However, coffee is not a homogeneous product since quality (as measured by cup tasting), production method, and origin all play a role. In addition, homogenisation results in a loss of traceability[11].

Traceability gained much importance for almost all agricultural products with the shift from quantity-oriented agriculture to one where quality, safety, functionality, and sustainability are pertinent. Assuring the traceability of farm produce from farm to fork, implementing authenticity and diagnostic tests that detect and prevent farm-produce safety hazards, and preserving the identity and freshness of food products have become essential elements of agricultural supply chain management systems (Opara, 2003). Over recent decades, a set of voluntary and regulative laws and initiatives have attempted to bridge the information gaps between farmers, retailers, and consumers (Opara and Mazaud, 2001). Such traceability systems aim to reduce production uncertainty, opportunism, and incidences of moral hazards for products where quality monitoring costs are high and the product traits are difficult to identify (Buhr, 2003). Hence, in supply chains of different food products alike, traceability systems increases transparency in the supply chain, reduces the risk of liability claims, improves the effectiveness of recalls, enhances logistics, improves control of livestock epidemics, simplifies product licensing, reduces information asymmetry, decreases transaction costs, increases trust levels, and facilitates contracting for a price premium (Gellynck and Verbeke, 2001; Meuwissen et al., 2003**)**.

For coffee specifically, traceability systems could add value, especially by transmitting information on quality and coffee-production type that is obtained through certification,

[11] In this study, traceability is perceived as the ability to identify the origin of the coffee to the most relevant level of aggregation along the supply chain. Essentially, traceability refers to information that is transferred between actors throughout the whole supply chain, from the single plot within a farmer's landholding to a single farm household, the collective of farmers, the processing station, the supplier, and the national market; and which can be traced backwards (ECX, 2010).

production system, and origin (for example, single origin coffee and rainforest alliance). However, critics argue that the way in which the ECX handles its coffee trade operations is reducing traceability more than it is enhancing it. The main ECX coffee trade is said to result in commoditisation, whereby coffees with considerable diversity in cup taste, and that are spatially grown, are merged towards homogenisation. Thus, coffee that passes through the ECX is said to become less distinct in cup taste and to become non-traceable, either in terms of quality or grower origin. As such, the ECX-sourced coffee is a less differentiated product, although it may be of different quality at the farm level (Leung, 2014). According to Leung (2014), monetary losses can be substantial when origin labelling disappears, especially for well-known and reputable coffee varieties. Moreover, the Ethiopian government essentially endorsed commoditisation, as indicated in a 2011 directive that all export coffee should be shipped in bulk containers. Previously, the industry practice was to store coffee in 60kg jute bags, with the advantage of having different coffee lots being transported in a single container while maintaining lot separation. Shipment in bulk containers would require large overseas wholesalers to repackage coffee beans, forcing many medium-sized distributors and specialty coffee roasters, who used to buy small volumes, out of the market (Mezlekia, 2011).

The ECX established the Direct Specialty Trade (DST) that traded fully traceable coffee. Prior to a monthly DST auction, the ECX posted information on individual lots on its website, including the grower, geographic origin, and cup profile. With the resulting quality certificate in hand, producers and local traders were able to sell at the Specialty Trade platform. In addition, international buyers could pre-register for the session and were invited to participate in a cupping session prior to the bidding (ECX, 2010; Leung, 2014). The platform was initiated in February 2010, but it did not meet expectations. The ECX held only 15 auctions on the platform and ceased the operation thereof in 2011. As a result, exporters were unable to process their own specialty coffees (Mezui et al., 2013).

In the aftermath of market reform, including the demise of the DST, most of the smallholder coffee producers were left with no other options but to market their coffee through non-traceable channels. Some found an alternative chain which was put in place with the help of donor institutions and cooperative unions. Only a limited segment of coffee producers could market through fully traceable market channels. The peculiarity of this alternative channel is that it is the cooperatives with certifications that allow traceable trade. The certification includes fair-trade, organic, rainforest alliance, and/ or fair-trade-organic. The coupling of certification with traceability enables the cooperative members to widen their outlet options. Thus, the operation has the intention of shifting the coupling of certification with traceability

from an alternative market channel to the mainstream market. It is however noteworthy to mention that this 'de-commodified' channel is still of minor importance compared to the ECX. The majority of the coffee production in the study area is traded through the ECX.

The current research was motivated by an earlier study by Jena et al. (2012), who conducted similar research in the Jimma zone. For the present study, gaining further insight into the outcomes that small-scale coffee producers may observe from being members of, and selling through certified cooperatives, is of particular interest. The study by Jena et al. (2012) is limited to the impact of certification and does not consider the impact of the market reform as a result of the establishment of the ECX. Therefore, the current study aims to investigate whether producer marketing through the alternative chain leads to more economic benefits than producer marketing through the ECX chain. Furthermore, the study also aims to compare different cooperatives.

Previous empirical research conducted by Allison (2009), Frenette (2010), Bjerga and Patton (2011), and Leung (2014), that studied the impact of traceability in the coffee sector is limited to macroeconomic perspectives. However, over the past decade, studies on coffee-producing households have explored issues relating to the impact of coffee certification on sustainable development, asset endowments, sustainability of certified coffee production, and poverty (Valkila, 2009, Barham and Weber, 2012, Donovan and Poole, 2014; Chiputwa et al., 2015). These studies predominantly highlighted the impact of different types of certification on the financial capital, productivity, natural resources, poverty, and sustainability of the farm household.

This study makes use of a propensity score matching approach to compare data from small-scale coffee producers who are members or non-members of cooperatives in South-West Ethiopia. The analysis aims to test whether membership has a direct effect on the coffee production outcomes, including production, productivity, and price at which the coffee is sold, as well as on livelihood outcomes. These livelihood indicators are inspired by the sustainable livelihood approach.

6.2 Empirical challenges

Potential biases are expected in the selection of certified and traceable cooperatives as well as the selection of farmers to be interviewed. There are various reasons for the presence of biases. One such reason is that farmers marketing through a certified and traceable value chain, compared to the ECX market, might vary in several community and household-level characteristics, which may have a direct impact on producer welfare. For

example, farmers selling through the certified and traceable value chain might experience differences in the average size of coffee holdings, climactic working conditions, market access, practices, and the distances to input markets than farmers selling to the ECX. Therefore, the differences observed between the two groups of producers (members of cooperatives and non-members) may, either completely or partially, show basic differences explaining their willingness to be members of a cooperative, rather than the effects of certification and coffee sales through the alternative channel (Bernard et al., 2008).

A second reason for expected biases is that self-selection bias could arise from unobservable community or household characteristics. For instance, the existence of such certified cooperatives might be initiated by active community leaders in the area where the cooperative is established. At the farmer level, entrepreneurial spirit, motivation to prosper, a household's risk preference, or its relationship to other certified and traceable cooperative members may correlate with self-selection (McKenzie, and Yang, 2010).

Thirdly, the externalities or spill-overs that arise from certified cooperatives on the decisions and participation of both the members and non-members may be important. For instance, certified and traceable cooperatives could influence the coffee price offered by other buyers to non-members and members of non-certified cooperatives (Bernard et al., 2008).

To overcome these potential biases, this study uses a propensity score matching approach. Data were collected from member of certified cooperatives as well as non-members. The non-members who were interviewed were selected from areas where no certified cooperatives are present. The areas with and without certified and traceable cooperatives were matched by accounting for important determinants such as market access, agro-ecological potential, population density, and remoteness. The researcher then matched certified and traceable cooperative members to similar households in other areas without cooperatives. The potential bias for self-selection in a certified cooperative was minimised by selecting cooperatives which were only initiated by external partners (in this case, the NGO Technoserve). In this regard, the establishment of the certified and traceable cooperatives was exogenous to the communities' decision-making processes. Furthermore, in order to control the spill-over effects of sharing the same market, the researcher ensured that the treated and control groups did not share the same local market.

The sustainable livelihood approach (Ellis, 2001) inspired the choice of livelihood indicators on which the impact of the cooperative membership was measured. The livelihood approach assumes that households own a certain amount of capital/ assets which they invest in a livelihood strategy. Ellis (2001) distinguishes between natural, human, physical, financial, and social capital. Livelihood strategies may exist of one or more sources of income. A household will typically invest in a livelihood portfolio that, depending on the level of capital and personal preference, and mediated by the institutional/ market/ natural environment, is diversified across agricultural, non-farm, and migration activities. This livelihood portfolio allows the household to earn an income, access food, and secure a livelihood. Moreover, surplus 'income' can be saved or invested in the accumulation of household capitals (Ellis, 2001).

It is assumed that small-scale coffee producers consider coffee farming as part of their livelihood. Therefore, they will allocate land to coffee and invest time and money into it in order to make coffee part of their livelihood portfolio. Membership of a certified cooperative and sales of certified coffee may enhance the coffee production if it allows the farmers to gain benefits in terms of price at which coffee is sold, sales volumes, as well as net and gross revenues from coffee. This involves de-commodifying the coffee, in other words, creating a conducive institutional environment. In turn, this may feed back into the household livelihood if the gains are invested in the household capital. Furthermore, the impact on human capital is measured by the possible difference in women empowerment of cooperative membership. The indicators for physical capital include values of asset levels; impact on financial assets is tested through measuring the impact on income levels from other crops, nonfarm income, savings. The number of trees planted is an indicator of natural capital and finally social capital may be enhanced in terms of the membership to associations.

6.3 Methodology

6.3.1 Study area, data collection and sampling

6.3.1.1 Study area

This study focuses on the Jimma and Kaffa zones in Southwestern Ethiopia (Figure 1.3). The two zones were selected for their potential and long experience in coffee production. The Jimma zone is composed of 13 woredas, with a population of over 2.8 million (CSA, 2014). The elevation ranges from 880m to 3360m above sea level. The zonal agro-

ecological setting is stratified as highlands (15%), mid-lands (67%), and lowlands (18%). The zonal rainfall coverage ranges from 1200–2800mm per annum. In normal years, the rainy season extends from February to October. Maize, teff, sorghum, barley, pulses, root crops, and fruit are other major crops in addition to coffee.

The Kaffa zone has a total area of 10602 km^2 and lies at an altitude of 500m to 3500m above sea level. In 2014, this zone had a total population of 858 600 with a population density of 90 people per km^2. Most of the land consists of mid-land (59%), followed by lowland (29%), with 11% being classified as highlands. The mean annual temperature of the zone ranges from 10.1 to 27.5°C with a mean annual rainfall of 1001-2200mm. Of the total area of land in the zone, 23% is cultivated, 32% is forestland, 6% is grazing land, 25% is cultivable land, and the remaining proportion is uncultivable land.

6.3.1.2 Data collection and sampling

In southwestern Ethiopia, the major coffee growing areas are the districts of Jimma and Kaffa, where farmers allocate most the cultivable land to coffee production. In these districts, certified coffee cooperatives participating in the traceable coffee market were identified. From the two zones, five traceable and certified cooperatives from Kaffa, and a further 22 from the Jimma zone, trading in the traceable market, were identified. Cooperatives participating in the certified traceable coffee market for less than two years and cooperatives which did not pay dividends to their members were excluded from the treatment group. The remaining cooperatives were then categorised according to their certification system (organic, fair trade, organic and fair trade, rainforest alliance, and forest coffee). Rainforest alliance certification began during the survey year. Once the certified cooperatives in the two zones were classified into the different types, these cooperatives were further classified by size.

From the identified set of certified cooperatives, three cooperatives from Kaffa and six cooperatives from Jimma were selected. Thereafter, totally, 292 household heads were selected according to the sample size determination table at alpha 0.05 (Bartlett et al., 2001. While selecting members, their affiliation with the cooperatives with consistent sales of a reasonable quantity (30-40%) of their coffee production through the certified and traceable routes over the past two years was considered. Thus, the populations under study included coffee producers and their families whose productive units were small and who were producing coffee at a small scale under rather homogeneous environmental and social conditions. After minimising the possible sampling biases, the propensity scores that

were used to match the 292 household members in the certified cooperatives with 332 households among the comparison group were estimated. Producers under the comparison group were selected based on certain similarities to the producers under the treatment group. These included areas with similar altitude, population density, distance to the closest market, and moisture reliability. Finally, each household's propensity score (explained as the probability that a household would participate in a certified and traceable cooperative, given a set of observable characteristics) for joining a certified and traceable cooperative was estimated.

6.3.2 The propensity score matching method

For this study, a semi-parametric matching estimation technique was applied to evaluate the impact of certification and traceability on the producers' welfare. Matching estimations are often used to evaluate the aftermath of policy reforms at different stages. Here, it is assumed that the difference in outcomes between the treatment and the control group may be attributed to the certification of the coffee at sales which makes it traceable through a cooperative setting (Stuart, 2010).

If $Z_J(0)$ is the welfare of producer J if he had not participated in certified and traceable channels and $Z_J(1)$ is the welfare of the same producer if he had participated in certified and traceable channels, and both welfare levels were simultaneously observed, the impact of certification and traceability on the welfare of producer J, $Z_J(1) - Z_J(0)$, would be directly observable. However, a primary issue with this measure is that $Z_J(1)$ and $Z_J(0)$ are not simultaneously observable. In other words, as Wooldridge (2002) explains, an individual cannot be in both conditions and thus, a counterfactual cannot be measured.

Essentially, it is difficult to observe the outcome variables for producers marketing through certified cooperatives in case they market their coffee through the conventional channel. Likewise, it is not possible to observe the outcome variables for producers who market through the conventional channel if they market their coffee through cooperatives. Therefore, the propensity score matching (PSM) model, as developed by Rosenbaum and Rubin (1983, 1985), was used to create counterfactuals for the set of producers marketing through certified cooperatives. PSM constructs a statistical comparison group by matching producers marketing coffee through certified cooperatives with producers with similar characteristics marketing through the ECX. Following Heckman et al. (1997), Z_1 is the value of a producer's welfare when the producer J is subject to treatment. More specifically,

a certified cooperative (Q = 1) and Z_0 would be the same variable when they do not market through a certified cooperative (Q = 0). The observed producer's welfare is

$$Z = Q\,Z_1 + (1 - Q)\,Z_0 \quad \text{Eq. 1}$$

When Q = 1 we observe Z_1; when Q = 0 we observe Z_0. The average effect of treatment on the treated (ATT) is defined as

$$ATT = E(Z_1 - Z_0 \mid Q = 1) = E(Z_1 \mid Q = 1) - E(Z_0 \mid Q = 1) \quad \text{Eq. 2}$$

Hence, we can only observe the outcome variable for producers marketing through certified cooperatives E (Z_1 | Q = 1); however, we cannot observe the counterfactual E (Z_0 | Q = 1). Therefore, PSM matches the treatment and control based on counterfactual analysis.

The three primary assumptions underlying matching estimators are i) the balance property of the propensity scores, ii) the conditional independence assumption, and iii) the common support requirement. Therefore, the conditional independence assumption (CIA), common support condition (CSC), and overlap assumption need to be tested. CIA implies that, based on a set of covariates that are not affected by certification, disparity in outcomes between participants and non-participants result from selling coffee through certified cooperative. Hence, the selection of the set of covariates is crucial in the process of matching estimators (Wooldridge, 2002). Caliendo and Kopeinig (2008) further suggested that covariates included in the estimation process should simultaneously determine the treatment and the outcome variable, which can be written as:

$$(Y_0, Y1) \perp Q \mid X \quad \text{Eq. 3}$$

CSC is the second important requirement for conducting the matching between the treatment and control groups. Heckman et al. (1997) stated that only comparable observations X can be matched on the overlapping subset of the participant and non-participant groups. The overlap condition is defined as follows:

$$0 < P(D = 1|X) < 1 \quad \text{Eq. 4}$$

The overlap assumption explains that individuals with the same X values have a probability for being considered as a member and a non-member (Caliendo and Kopeinig, 2008). Thus, the balancing property of the propensity score assumption relies on the fact that the matching property is genuine and states that treated (0=1) and control (0=0) groups with the same propensity score e(y) have the same distribution as the observed covariates "x" (Rosenbaum and Rubin, 1983).

$$\Pr\{y|Q = 1, e(y)\} = Pr(x|Q = 0, e(x)\} \quad \text{Eq. 5}$$

The phrase “balancing property” means that, while we make a comparison between two groups, it is necessary to control the propensity score. This allows us to effectively turn the observational study into groups of subjects with the same propensities. Equation 3 stipulates that the treatment Q has to be independent of all observations y, conditional on the probabilities e(y) when they would receive the treatment. Failure to satisfy the condition of CSC is a primary source of bias due to incomparable individuals (Heckman et al., 1997). Furthermore, to check the robustness of the results, the study makes use of three matching techniques, namely kernel matching (KM), nearest neighbour matching (NNM), and radius caliper (RC).

6.3.3 Treatment heterogeneity

It is a major challenge to address self-selection bias in impact studies. The bias is induced by producers’ self-selection in the certified channels for reasons that are unobservable, such as risk-taking capacity or the social relationships with other coffee producers. As a result of the unobserved household heterogeneity, one cannot guarantee that the treatment will have a homogeneous impact on the producers. To avoid self-selection bias at the producer level, Xie et al. (2011) propose two methods, namely (a) the stratification multilevel-heterogeneous treatment effect (SM-HTE), and (b) the matching smoothing-heterogeneous treatment effect (MS-HTE).

The SM-HTE estimation method firstly calculates the propensity scores based on the given covariates and then splits the whole range of propensity scores obtained into different strata and assumes homogeneity within these strata. The effects of the treatment are interpreted through the comparison of outcome variables between the treatment and control groups across each of the strata. After the estimations in each of the strata are calculated, a linearity trend is estimated to show whether the treatment has established a positive or negative functional effect over the propensity scores (Xie et al., 2011).

The MS-HTE addresses some of the weaknesses of the SM-HTE method. One weakness being that the SM-HTE considers homogeneity within the strata and uses the treated and the control variables interchangeably as it assumes there is no heterogeneity within the strata. Another weakness involves the linearity assumption between the ranges of strata to detect the treatment heterogeneity. In contrast, the MS-HTE estimation method firstly estimates the propensity scores for the treatment and matches the treated with the control observations. Thereafter, individual level treatment control comparisons are

constructed. The heterogeneity pattern is revealed through a nonparametric model by estimating the treatment effect as a function of the propensity score (Brand and Thomas, 2013). This study made use of local polynomial regression to estimate a pattern of treatment-effect heterogeneity.

6.4 Result and discussion

6.4.1 Farm characteristics and matching coffee producers

As shown in Table 6.1, the farm area allotted to coffee production was larger for the members of the certified cooperatives, while they had less land covered by other crops. Members of the certified cooperatives had larger numbers of productive and regenerating coffee trees, as well as a higher proportion of coffee-related income. They were relatively better educated and had more years of experience in coffee farming, whereas producers in the control group had more family members actively helping them on the farm.

As previously mentioned, a matching algorithm proposed by Rosenbaum and Rubin (1983) was used to identify a set of producers in the control group who are similar to treated producers in terms of relevant household and farm characteristics, except for participation in the cooperative, and hence participation in the certified and traceable market chain. A test to validate the matching procedure was conducted by comparing the household characteristics for farmers in the treatment group (i.e. members of, and selling their coffee through, certified cooperatives) with similar characteristics for the control group.

Table 6.2 portrays the results of the Probit model that was used to match members of the certified cooperative to those that were most comparable in the control group. It was deduced that certain personal characteristics played a role in the likelihood to be a member of a certified cooperative. Male, elderly, and better educated producers, with larger families, were likely to be a member of a cooperative. Similarly, producers with more land dedicated to coffee production and less to the production of other crops, were more likely to be members. In contrast, producers located at further distances from credit institutions had a higher tendency to market their coffee through certified cooperative channels.

Table 6.1 Mean difference in household and farm characteristics between treated and control group

Variable	Treated Mean	Std. Dev	Control Mean	Std. Dev	t-statistics
Sex of the household head (0=male,1= female)	0.07		0.05		1.28
Age of the household head (number)	45.01	11.68	43.85	11.34	1.56
Education level of the household head (number)	4.67	3.21	3.11	2.67	6.61***
Family size (number)	5.67	2.19	5.09	2.04	3.31***
Dependency ratio (number)	0.37	0.22	0.36	0.22	0.45
Years of experience in coffee farming (number)	17.73	10.03	16.57	8.35	1.52
Radio ownership (1= yes, 0= no)	0.83		0.68		4.12***
Asset value up to 2009 (birr)	53147	80307.63	36748	42693.85	3.23***
Coffee share of total income	0.78	0.22	0.76	0.22	1.23
Wet-processed coffee price (birr) in 2010	9.71	1.22	9.27	1.67	3.71***
Coffee area (ha) in 2010	1.05	0.91	0.77	0.68	4.40***
Other crop area (ha) in 2010	0.83	0.75	0.95	0.76	-2.07***
Total regenerating coffee trees (number) in 2010	818.02	3079.89	583.55	1919.36	1.03
Total productive coffee trees (number) in 2010	3281	2540.35	2282	1879.72	4.59***
Total coffee production in 2009 (in kg)	1813	2247.05	1445	1761.75	2.29**
Wet-processed coffee production in 2009 (in kg)	683.69	1107.95	441.39	903.01	2.99***
Distance to the market (in minutes)	4.10	6.57	4.44	3.82	-0.94
Distance to the credit institution (in minutes)	22.90	39.18	12.43	8.03	4.77***
Extension contact (in number)	3.56	1.91	3.38	1.96	1.13
District (0 = Jimma, 1= Kaffa)	0.61		0.77		-4.45***

***, **, represent 1%, 5%, levels of significance

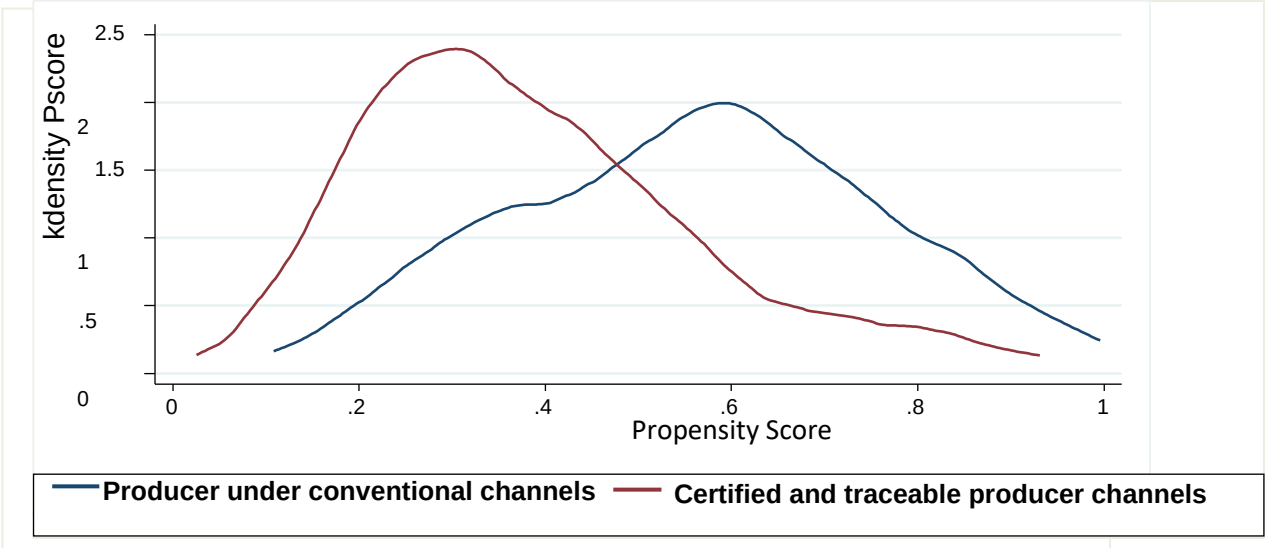
Table 6.2 Probit estimates of determinants of participation in certified coffee cooperatives

		Coefficient	P-value
Sex of the household head		0.638***	0.005
Age of the household head		0.019***	0.001
Education level of the household head (years of schooling)		0.129***	0.000
Family size (number)		0.078**	0.012
Dependency ratio (number)		-0.043	0.877
Years of experience in coffee farming		0.001	0.923
Asset value until 2009		0.000	0.124
Radio ownership (1= yes, 0= no)		0.312**	0.020
Extension contact (in number)		0.005	0.864
Distance to the credit institution (in km)		0.012***	0.000
Distance to the market (in km)		-0.002	0.865
Coffee area (ha) in 2010		0.271***	0.001
Other crop area (ha) in 2010		-0.376***	0.000
_cons		-2.300***	0.000
LR chi2(12)	136.4	Pseudo R2	0.159
Prob > chi2	0.00		
Observation	621		

Note: ***, **, indicate statistical significance at 1%, 5% respectively

The current study limits the samples to the common support region. These common regions were constructed after removing the observations in the control group with a p-score value of less than the minimum p-score value in the treated group. Likewise, observations for the treated group with a p-score higher than the maximum p-score in the control group were removed. As shown in figure 6.1, 17 observations for the treated group fell outside the common region., whereas all of the control group observations fell within the common region.

A. Full range area



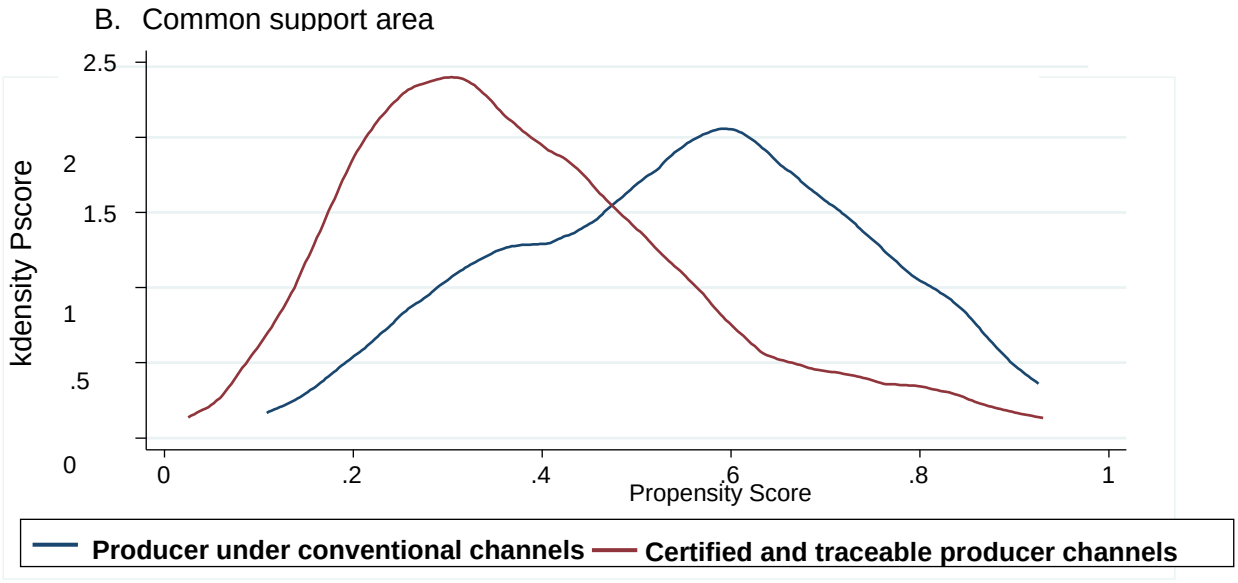


Figure 6.1 Propensity scores distribution for traceable and non-traceable coffee producers before and after matching

6.4.2 Average impact of certification and traceability on producer's welfare

The results of the average impact of certification and traceability on coffee producers' welfare are displayed in Table 6.3. The overall benefits of marketing through certified and traceable channels was given for variables of coffee production, and selected indicators for human, physical, financial, natural, and social capital.

The negative impact of certification on coffee yield was found in the KM model. Yields of non-cooperative producers were found to be significantly higher with an ATT of 1350.63kg. This may be as a result of the requirements of sustainable production and harvesting procedures commanded by the coffee cooperatives (Ruben and Fort, 2012), or, as mentioned during the fieldwork, caused by older plantations with limited regenerating trees.

Members of certified cooperatives tend to sell more wet-processed coffee and less dry-processed coffee. This is explained by the negative causality between certification and traceability with dry-processed coffee production (van Rijsbergen et al., 2016). Moreover, the price of wet-processed coffee was found to be generally higher for members of the certified cooperatives. Figures 6.2 and 6.3 compare the price variance between member producers and non-members. Most of the producers marketing though certified and traceable channels were trading in a narrow price range, while there were more price differences amongst that received by the conventional producers.

It is however of interest to note that the higher price that producers received for their wet-processed coffee did not enable them to increase their gross coffee income above the

levels reached by non-members. This finding was also noted by, amongst others, Valkila (2009) and Ruben and Fort (2012). In addition, the impact of cooperative membership on net cash return was not significant. Coffee price, yield, and cost per hectare were taken into consideration to calculate net cash returns from coffee. Thus, the impact of the relatively higher price that the certified and traceable coffee producers received was not sufficient to overcome lower yields and higher costs (Barham and Weber, 2012).

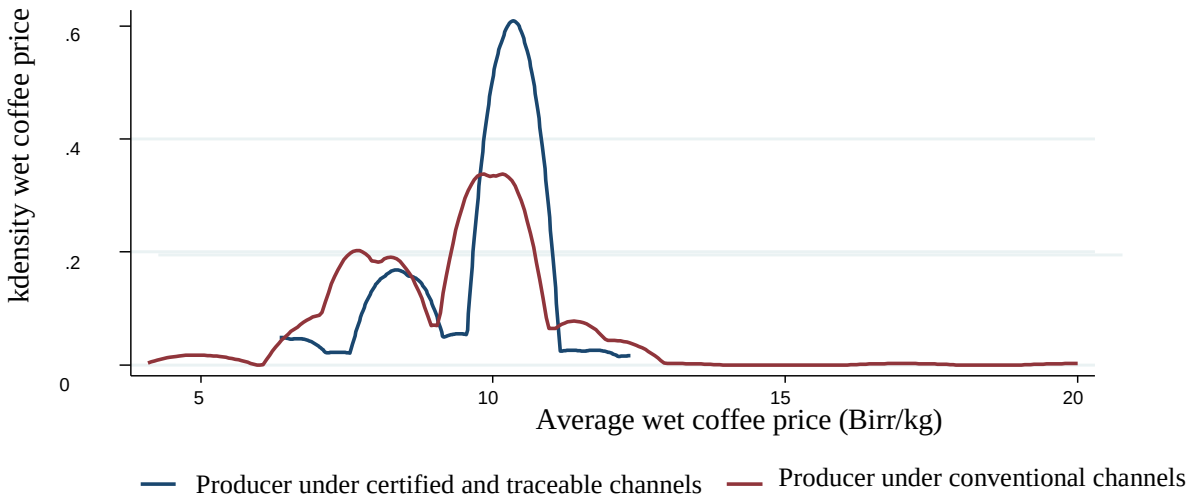


Figure 6.2 Price variance of wet-processed coffee between treated and control producers (Birr/kg)

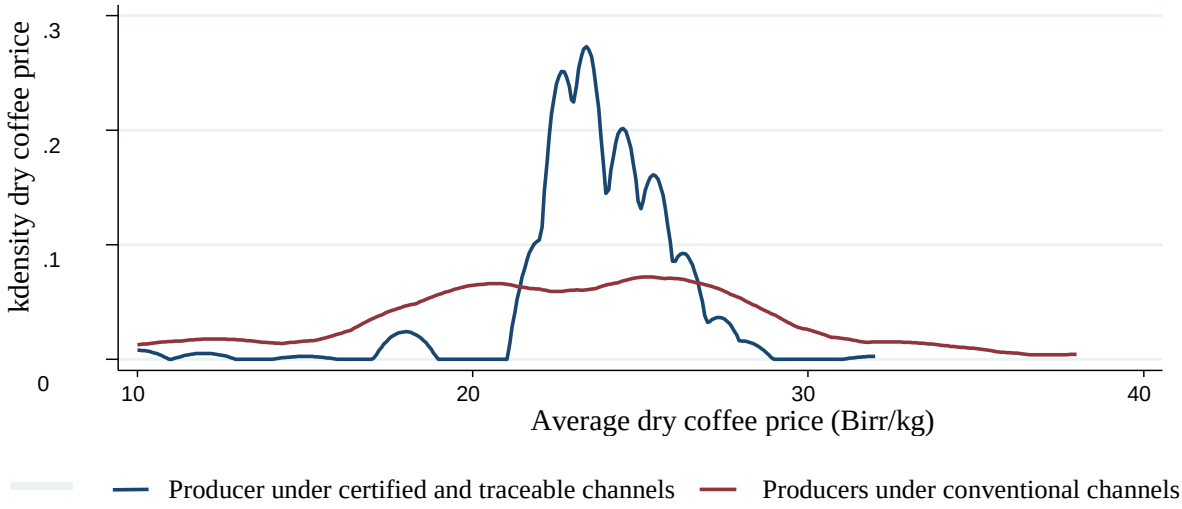


Figure 6.3 Price variance of dry-processed coffee between treated and control producers (Birr/kg)

The sales of coffee through the certified cooperatives did not impact on the gender division of the decision-making within the household. Due to the slow behavioural change in a farming household, investment in human capital is relatively low for coffee producers (Donovan and Poole, 2014). The results on the impact of certification and traceability on the physical capital of the coffee producers were more conclusive. The estimated asset value of producer households since 2010 (after they started selling through a certified channel) was found to be significantly higher for treated producers. Producers who were members of the cooperatives seem to have owned more durable assets, as was also shown by Kamau et al. (2010). However, the results were inconclusive in terms of how certification and traceability increases agricultural assets.

The matching estimation results show that producers who are member of certified cooperatives had significantly lower incomes from other crops as compared to non-members. Participation in certified and traceable market channels appeared to have no statistically significant differences in non-farm income. Interestingly, cooperative members had more savings as compared to the non-members.

In addition, members of the certified cooperatives engaged more in land conservation practices, tree planting, and organic fertiliser application as compared to non-members. Furthermore, training and awareness creation provided by the certified coffee cooperatives to members also enabled them to follow sustainable coffee production practices. This finding was also highlighted by Donovan and Poole (2014). Finally, another important effect was producers' participation in social groups.

Table 6.3 Average impact of certification and traceability on coffee producer's welfare

Variable	Kernel			Five nearest neighbors matching			Radius caliper		
	Difference	S.E.	t-stat	Difference	S.E.	t-stat	Difference	S.E.	t-stat
Coffee production outcomes									
Coffee yield (kg/ha)	-1350.63** (480.51)	590.06	-2.29	-633.04 (632.76)	603.95	-1.05	-957.69 (469.41)	642.44	-1.49
Wet-processed coffee production (Kg)	202.27* (90.40)	107.42	1.88	255.28** (112.55)	107.61	2.37	190.96* (102.90)	114.16	1.67
Dry-processed coffee production (Kg)	-601.77*** (272.40)	123.05	-4.89	-169.65* (113.48)	101.40	-1.67	-558.91*** (217.89)	135.95	-4.11
Average wet-processed coffee price(Birr/kg)	0.28* (0.15)	0.15	1.79	0.41** (0.22)	0.17	2.32	0.34* (0.15)	0.17	1.95
Average dry-processed coffee price(Birr/kg)	0.68 (0.52)	0.50	1.35	0.82 (0.72)	0.59	1.38	0.74 (0.47)	0.56	1.32
Gross coffee income per hectare(Birr/hectare)	-9563.31** (6450.54)	4302.59	-2.22	3243.51 (4343.55)	3883.52	0.84	-8277.83* (4806.97)	4673.56	-1.77
Cash cost per hectare(Birr/hectare)	14.40 (65.15)	10083.88	0.22	16.13 (105.15)	84.43	0.19	16.13 (57.90)	71.81	0.71
Net cash revenue per hectare(Birr/hectare)	-12172.80 (5929.92)	66.22	-1.21	-3588.07 (7874.72)	7516.62	-0.48	-7810.93 (4980.04)	11199.12	-0.70
Livelihood outcomes									
Human capital									
Decisions made by male(number)	-0.01 (0.04)	0.04	-0.24	-0.02 (0.05)	0.04	-0.58	-0.03 (0.04)	0.04	-0.75
Decisions made by female(number)	0.014 (0.02)	0.02	0.51	0.05* (0.02)	0.02	1.81	0.04 (0.018)	0.02	1.51
Physical capital									
Asset value since 2010(Birr)	13263.96*** (2667.14)	2872.47	4.62	12724.60*** (5264.91)	3660.28	3.48	12672.93*** (2525.78)	3031.86	4.18
Durable asset since 2010(Birr)	13183.79*** (3039.56)	2873.21	4.59	12632.76*** (5675.43)	3661.37	3.45	12581.71*** (3234.84)	3032.64	4.15

Agricultural asset since 2010(Birr)	18.53 (14.66)	20.13	0.92	26.87 (22.16)	19.28	1.39	15.26 (15.13)	22.06	0.69
Financial capital									
Income from other crops(Birr)	-4520.76*** (1989.03)	1609.90	-2.81	-4766.29** (2269.54)	2210.65	-2.16	-5084.42*** (2189.71)	1816.39	-2.80
Nonfarm income(Birr)	-159.02 (880.48)	830.55	-0.19	348.070 (905.47)	764.49	0.46	-533.89 (837.35)	907.76	-0.59
Saving amounts(Birr)	3349.21*** (724.43)	747.80	4.48	2791.28*** (905.78)	791.00	3.53	3211.35*** (752.28)	748.51	4.29
Total gross income(Birr)	-49750.00 (26879.07)	64457.01	-0.77	-78016.70 (110310)	93704.41	-0.83	-52166.20 (32074.03)	72990.40	-0.71
Natural capital									
Practice land conservation practices(Yes/No)	0.14*** (0.03)	0.03	4.47	0.17*** (0.03)	0.03	4.64	0.15*** (0.03)	0.03	4.28
Number of trees planted(number)	46.08*** (13.62)	14.04	3.28	47.41** (23.86)	19.26	2.46	48.17*** (15.14)	14.69	3.28
Use organic fertilizer(Yes/No)	0.08* (0.05)	0.05	1.76	0.06 (0.06)	0.05	1.03	0.11** (0 .05)	0.05	2.04
Social capital									
Satisfaction in social organizations(level)	0.20 (0.03)	0.15	1.34	0.08 (0.19)	0.18	0.45	0.15 (0.17)	0.16	0.93
Association membership(number)	0.11*** (0.01)	0.01	6.20	0.13*** (0.02)	0.02	5.78	0.12*** (0 .01)	0.02	5.92

Note: ***, **, * represent 1%, 5%, and 10% levels of significance

6.5 Sensitivity Analysis

6.5.1 Robustness of matching algorithm

Since every matching algorithm has its operational limitations, Baser (2006) suggested checking the robustness of the estimated ATT for different matching algorithms. Bryson et al. (2002) and Stuart (2010) further stressed the need to check whether the sample and model satisfy the common support conditions. The different matching methods were tested using the covariate balancing tests. The results presented in table 6.4 suggest that the different algorithms are robust. The robustness test results also suggest that the Pseudo-R^2 values were significantly lower (approaching zero, which is a sensible result) after matching than before matching for the different algorithms. Furthermore, the mean standardised bias diminished significantly for all algorithms after matching.

Table 6.4 Robustness of the different matching algorithms

Matching Method	Kernel matching	Nearest Neighbor (5)	Radius Caliper (0.01)
Replacement	Yes	Yes	Yes
Common support	Yes	Yes	Yes
No. of treated	292	292	292
No. of control	332	332	332
Pseudo R^2 before matching	0.159	0.159	0.159
Pseudo R^2 after matching	0.020	0.009	0.017
P > χ^2 before matching	0.000	0.000	0.000
P > χ^2 after matching	0.306	0.988	0.492
Mean standardized bias before matching	21.5	21.5	21.5
Mean standardized bias after matching	7.0	4.3	7.4

6.5.2 Sensitivity of ATT to hidden bias

The aforementioned matching models may be biased as a result of unobservable farm and household characteristics in which the two groups might differ. This may cast doubt on the true impact of certification and traceability on the welfare of the coffee producers (Caliendo and Kopeinig, 2008). Therefore, the Rosenbaum (2002) bounds sensitivity tests were performed to check if the measured certification and traceability impacts are distorted by hidden factors not observed in the dataset (Table 6.5).

Table 6.5 Sensitivity of ATT to unobserved bias

Variable	Producers under certified and traceable channels	Producers under conventional channels	ATT	Critical value of gamma
Coffee yield	2936.31	4361.43	-1425.12 (537.62)	4.8-4.85
Dry-processed coffee production	595.54	1000.82	-405.27 (233.79)	5.1-5.15
Asset value since 2010	22164.44	7589.30	14575.13 (3000.006)	1.4-1.45
Durable asset since 2010	22077.82	7607.74	15.96 (15.91)	1.35-1.4
Income from other crops	1375.08	5747.07	-4371.99 (1373.46)	10.6-10.7
Saving amount	3258.94	71.58	3187.35 (813.13)	1.35-1.4
Membership in social organizations	0.30	0.17	0.12 (0.017)	4.95-5
Practice land conservation practices	0.47	0.30	0.17 (0.02)	3.1-.3.15
Number of trees planted	126.19	83.34	42.85 (13.37)	1.7-1.75

Rosenbaum bounds (rbounds) test estimates the gamma level to test the hypothesis that the treatment impact is not affected by unobserved selection biases. Gamma level is explained as the odds ratio of differential treatment assignment due to an unobserved covariate. The critical levels of gamma (Γ) are shown in the last column for the different welfare indicators that show significant differences between the two groups. As shown in table 6.5 the lowest critical value of sensitivity analysis is 1.35–1.4, whereas the largest critical value is 10.6-10.75. The gamma level of 1.35–1.4 shows that producers that have similar covariates must differ in their odds of

certification and traceability by a factor of 35-40% to offset the positive significant effect of certification and traceability on durable assets and savings. To this study, the critical levels appear sufficiently high. Hence, as suggested by the sensitivity tests, the ATT estimates for the welfare indicators seem robust to unobservable covariates.

6.6 Heterogeneous impact of certification and traceability

While computing the aforementioned ATT, it was assumed that certification and traceability have a homogeneous effect on the coffee producers. However, previous studies (Bernard, 2007; Abebaw and Haile, 2011; Brand and Davis, 2011; Mutuc, 2013; Verhofstadt and Maertens, 2014) have shown that even farm households in the same treatment group, differ in their responses to the same interventions. To critically evaluate the heterogeneity effect of the treatment, the current study applied the heterogeneity models as developed by Xie et al. (2011), which include the SM-THE and MS-THE as previously discussed.

6.6.1 Stratification Multilevel- Heterogeneous treatment effect

Following the SME-HTE method, the certification and traceability effect on the producers' welfare across the strata was estimated by the following the ordinary least square (OLS) estimation equation:

$$O_{ab} = D_b + O_a T_i, \quad \text{Eq. 6}$$

Where O_{ab} is the expected value for an outcome variable, O, for the a^{th} coffee producer in the b^{th} propensity score strata. D_b is the Level-1 intercept and T represents a variable for producers under certification and traceable channels. After calculating equation six, the slope is used to estimate the heterogeneity pattern across the different strata:

$$O_a = \alpha_0 + \Phi_i + \varepsilon_i, \quad \text{Eq. 7}$$

Where O_a are the estimated level-1 slopes, α_0 is the level-2 intercept, Φ_i is the level-2 slope, and ε_i represents an error term.

As shown in table 6.6 and appendix III, the wet-processed coffee production increased significantly with increasing propensity to engage in certification and traceability. Those producers between strata 3 and 6 increased their wet-processed

Table 6.6 Treatment effects by strata- SME-THE

Variable	Level-1 slopes						Level-2 slopes
	1	2	3	4	5	6	
Coffee yield(kg/ha)	-4576.6 (0.15)	-2021.1** (0.03)	-1973.4* (0.05)	-798.4 (0.14)	82.5 (0.94)	-3035.3** (0.02)	279.3 (0.41)
Wet-processed coffee production (kg/ha)	-65.4 (0.82)	-166.90 (0.28)	120.99 (0.52)	230.39 (0.31)	263.75 (0.26)	608.27 (0.28)	136.33* (0.05)
Dry-processed coffee production (kg/ha)	-566.08 (0.16)	-221.7** (0.03)	-66.45 (0.66)	-286.5*** (0.05)	-211.77 (0.39)	-2460.1** (0.04)	-13.55 (0.83)
Total assets (birr)	2383.83 (0.78)	6992.78** (0.02)	11789.6*** (0.00)	10705.8 (0.26)	14802.6* (0.05)	17702.9 (0.30)	2937.39 (0.15)
Durable assets(birr)	2366.44 (0.78)	6983.94** (0.02)	11773.84*** (0.00)	10556.22 (0.27)	14579.56* (0.05)	17676.54 (0.30)	2892.60 (0.15)
Income from coffee(birr)	2496.18 (0.62)	-4532.71 (0.15)	-2042.8** (0.02)	-3415.1*** (0.00)	-7906.2*** (0.00)	-2498.8** (0.04)	-289.07 (0.53)
Nonfarm income(birr)	-2643.7 (0.47)	-1711.26 (0.15)	-1757.90 (0.10)	317.31 (0.76)	1325.31 (0.52)	4301.76 (0.36)	1154.09** (0.04)
Saving amount(birr)	-38.84 (0.50)	1158.25*** (0.00)	3605.43** (0.04)	2236.68* (0.05)	4800.94 (0.10)	9145.81 (0.21)	1087.93*** (0.00)
Trust in social organizations(Yes/No)	0.18 (0.83)	1.41* (0.00)	0.85** (0.01)	0.46 (0.24)	0.98*** (0.00)	0.51 (0.43)	-0.12 (0.30)
Participation in social organizations(number)	0.05 (0.50)	0.12*** (0.00)	0.14*** (0.00)	0.05 (0.22)	0.14*** (0.00)	0.08 (0.28)	0.001 (0.93)
Practice of land conservation(Yes/No)	0.23** (0.04)	0.05 (0.24)	0.16* (0.00)	0.10* (0.09)	0.24*** (0.00)	0.13 (0.27)	0.02 (0.19)
Tree planting(number)	19.27 (0.62)	9.88 (0.45)	43.01*** (0.00)	50.39 (0.45)	43.23* (0.05)	91.00* (0.03)	13.23* (0.05)
Use of organic fertilizer(Yes/No)	0.04 (0.82)	-0.04 (0.53)	0.11 (0.20)	-0.03 (0.77)	0.19* (0.06)	0.08 (0.64)	0.04 (0.18)

Note: P-values in parentheses. ***, **, * represent 1%, 5%, and 10% levels of significance

coffee production at a rate of 136kg for every unit change of the propensity score. However, there was no statistically significant impact of dry-processed coffee production across the different strata of propensity to engage in certification and traceability. The financial capital measured in terms of the value of total assets, durable assets, and income from other crops varied over the propensity strata to engage in certification and traceability. Nevertheless, there was an increase in the non-farm income effects of certification and traceability as their propensity increased and the increasing effect was mainly observed for farmers in the higher order of the propensity strata (strata 4-6). Furthermore, in level 2 slopes, the effect of certification

and traceability on non-farm income increased by 1154 birr for every unit change in the propensity strata.

The strongest significant effect of certification and traceability was observed on producers' savings level. Under level 1, the effect on savings was significant in all the propensity strata except strata 1. The level 2 slope for producers' savings significantly increased at a rate of 1088 for every unit change in propensity strata (rank). Furthermore, the level 2 slope for the certification and traceability suggested that also tree planting increased, and it reached a maximum level in strata 6.

6.6.2 Matching Smoothing Heterogeneous Treatment Effects estimation

MS-HTE method has certain advantages over the SM-THE method. Unlike SME-HTE that assumes different strata, MS-HTE assumes homogenous strata and makes continues propensity score lines (Xie et al., 2011). In this study, coffee yield, dry-processed coffee production, total assets, durable assets, income from other crops, organisational membership, and practices of land conservation were not significant under the SM-HTE approach, but they became significant in the MS-HTE model (Appendix IV).

The negative effect of membership of certified cooperatives and traceability on coffee yield was more important for farmers with the higher propensity scores. Cooperative membership seems to have reduced dry-processed coffee production significantly for those farmers with the highest propensity scores. This finding is consistent with the SM-HTE results. The estimated value of total and durable assets was higher amongst producers with certification and traceability. Moreover, farmers with high propensity scores to participate in certification and traceability were less affected in their income. In addition, membership of social organisations increased as the propensity increased. Finally, certification and traceability had a positive effect on participation in land conservation practices, yet this effect was lower for farmers with high propensity levels.

6.7 Discussion and Conclusion

Certification and traceability are becoming mainstream in the global coffee industry. Interventions involving certification and traceability to enhance the livelihood of the coffee producers have a multidimensional impact. For this study, a matching model

was used to estimate how participation in certified and traceable coffee chains through cooperative membership affected the producers' livelihoods in different aspects.

Membership of certified cooperatives is believed to be strongly conducive to increase human capital as a linking bridge for the sustainable partnership between the producers and international buyers. Basic production knowledge (weed control, pruning, stumping, mulching, soil and water conservation, and other related skills) are needed for attaining the minimum quality standards set by the international buyers. Most producers are reluctant to adopt production techniques that require high operational costs (mostly labour), while others prefer to avoid risk and might not be willing to reinvest their coffee income into coffee production. Hence, training and strengthening human capital is of great importance. The Probit model indicated that producers with higher levels of education are more likely to be members of a certified cooperative. Yet, the propensity score model did not show any significant effects

Despite the sustainable production activities intensively adopted by the certified and traceable producers, the coffee yield was much lower amongst cooperative members as compared to the farmers in the control group. The older age (approximately older than 20 years) of the coffee trees remains a challenge. The old coffee trees are characterised by their high production volatility. Moreover, an effort to replace the old and unproductive coffee trees with improved varieties is lagging. In addition, the capacity of the farm households to invest in their coffee production was limited since, on average, 70% of the households' income comes from coffee production.

Furthermore, the models suggest that cooperative members did not produce more wet-processed coffee as compared to non-members. However, non-members produced more dry-processed coffee. The focus and promotion of wet-processed coffee production by the international coffee buyers made cooperatives gear their resources towards wet processing. Thus, most of the cooperatives own washing stations. Moreover, in the study area, the applicability of sustainable use of the water and treating the waste water is becoming part of most traceable coffee cooperatives. During the field visit, the researcher had the opportunity of viewing four cooperatives that had installed a semi-washed processing plant with the help of Technoserve. Regardless of the initial cost to purchase the pulper and demucilager unit, it is believed that the semi-washed processing plant saves up to 80% of the water consumption.

In this study, coffee income accounts for, on average, more than 70% of households' income. Engagement in the certified and traceable coffee channels enabled producers to fetch a better and more stable price for their wet-processed coffee supply. Yet, this higher price was not sufficient to substantially increase coffee income. In addition, the coffee income was not found to be significantly higher for cooperative members. The lower income levels may partly be due to the low coffee yield of certified and traceable producers. Furthermore, the quality requirements of the cooperative may be more important, which may have affected the eventual amount of coffee sold through the cooperative. To fully capture the financial position of the households, the study also estimated the net cash returns from coffee and production costs on inputs and labour. However, no significant differences were found.

Certification systems require coffee production to be sustainable. The current study found differences between the farmers selling through the cooperatives, and those who did not, in terms of their involvement in selective tree planting and land conservation practices. Cooperative members were more inclined to perform activities that could contribute to sustainable production. However, the lack of market-based approaches to promote environmental conservation create the notion that the sustainable coffee farming is not contributing to the well-being and economic prosperity of the coffee farmers. Thus, the introduction of such ecosystem services payment schemes could enhance the well-being of the coffee farmers and also protect the ever-increasing threat posed by global climate change on the coffee growing regions of Ethiopia.

The current results also indicate that farmers who are members of certified cooperatives were on average the wealthier farmers. They had higher levels of saving, and the estimated value of their assets was ultimately higher. As a final result, the study also showed that the impact of being a member of a certified cooperative differed greatly between the treated producers. The heterogeneity was analysed by comparing the different outcome variables across the producers' propensity to engage in certification and traceability. The heterogeneity tests revealed that farmers with a high propensity to engage in certified and traceable markets were more likely to supply larger volumes of wet-processed coffee. Moreover, farmers with high propensity to engage in certified markets were saving more, and possessed more assets.

In conclusion, the results from this study suggest that certification and traceability of the coffee sold increased the price that the farmers received. Yet, the

impact of income was limited due to lower productivity levels. Cooperative members sold wet-processed coffee instead of dry coffee, as was required by the cooperative. Members were more inclined to employ sustainability measures which may become beneficial for the producers in the long term. Hence, it cannot be concluded that trade through traceability channels improves the welfare levels of the farmers involved as compared to trade through ECX when measured by economic parameters. However, the welfare effect of more stable prices of the wet-processed coffee should not be underestimated, as well as the beneficial effects of increased involvement in sustainable practices.

Chapter 7

Conclusion

7.1 Revisiting and answering research questions

This doctoral study aimed to assess the impact of the establishment of the Ethiopian Commodity Exchange (ECX) on the price integration of Ethiopian coffees with the international market, as well as the price integration across the regional Ethiopian markets and across the main actors in the coffee chain. Furthermore, it aimed to investigate how small-scale farmers might benefit from selling their coffee through certified cooperatives, being the alternative market chain to the ECX. This section revisits the research questions that were subsequently answered in the previous chapters.

1. **Analysis of the cointegration of Ethiopian coffee prices with the major coffee exporting countries under origin differentials, before and after the establishment of the ECX**

Firstly, the researcher sought to investigate the price relationships of the different Ethiopian export coffees in relation to the prices at which coffees are internationally traded. Of particular interest was how these price relations may have changed with the establishment of the ECX. Thus, the cointegration of the prices of four Ethiopian export coffees (Harar, Yirgachefe, Sidama, and Jimma) and four international coffees (Robusta, Other milds, Colombian milds, and Brazilian naturals) was analysed. An autoregressive distributed lags model was used to conduct this analysis on the monthly price data.

Q1. Did the cointegration of the prices on the Ethiopian coffee market with international coffee prices change after the establishment of the ECX?

The results from the models for the pre-ECX period indicate that markets of all types of Ethiopian coffee established a long-run cointegration with the prices of Arabica coffees on the international markets. Despite the variety difference, Ethiopian coffees like Jimma and Sidama were integrated with Robusta coffee in the pre-ECX period. During the post-ECX period, all Ethiopian coffees, except Harar coffee, cointegrated only with Arabica types of coffees (other milds, Colombian milds, and Brazilian naturals). The price of Harar coffee did not integrate with the prices of any of the Arabica coffee types on the international market. Moreover, Harar coffee is traded in a different market and follows its own price trend. It is a premium and high quality

coffee that is in high demand at the Saudi market, which can explain the high prices it fetches and its lack of cointegration with other international coffee markets.

The general expectation that most Ethiopian coffees would have adjusted to the Brazilian coffee price on the international market could not be determined for the pre-ECX period. However, Ethiopian coffee prices adjusted more to prices of other milds coffees and Colombian milds. Similarly, in the post-ECX period, market distortions of the prices for Colombian milds coffee directly triggered price adjustments for most of the Ethiopian coffee types. This does not, however, indicate that price changes in the Brazilian coffee market did not affect Ethiopian coffee prices.

Furthermore, one particular limitation of this study is that other macroeconomic factors or trends, which could also have influenced the price integration, were not taken into consideration. Moreover, the price integration study did not account for the competitiveness of Ethiopian coffees in the international market versus other high quality, branded specialty coffees. As such, the prices of Ethiopian coffees were compared with those on the international market and, to a lesser extent, those of other specialty coffees.

Q2. What kind of price behaviour and relationship exists between coffees of different Ethiopian origin in the international coffee market?

Unlike most previous research, this study aimed to compare the prices of coffees from different Ethiopian origins to the international market price. The results suggest that prices of coffees from an origin known as lower quality adjusted more slowly to international price changes of the different Arabica coffees in the pre-ECX period. In contrast, coffees with origins known to produce better quality coffees seem to adjust faster. However, the establishment of the ECX appears to have changed the levels of cointegration. Thus, prices of coffees from areas known for their lower quality corrected faster to price changes in the international market, while prices of origins known for better quality coffee corrected slower. As previously mentioned, the price of Harar coffee began to deviate from the international price trends since it was traded in its particular niche market.

In sum, these findings showed how the Ethiopian coffees of different origin and quality integrated in the international coffee market. Furthermore, the results suggest

that the prices of most of the Ethiopian coffees were able to establish a price relationship with the international prices of Arabica type coffees. However, Harar coffee, which is considered as the Ethiopian premium coffee type, did not establish a price relationship with the international coffee market as it was able to establish its own market.

2. **Examine the extent of spatial price integration of major coffee-grower markets in Ethiopia, before and after the establishment of the ECX**

Q3. Does restriction of direct trade between coffee-growing regions affect the level of price integration?

This study set out to investigate if the levels of spatial coffee market integration in Ethiopia changed between 1998-2008 and 2008-2013 as a result of the establishment of the ECX. The extent to which prices of different markets integrated, despite there being a prohibition arbitrage trade between producer markets, was examined. The relationships between prices at six producer markets located in the major coffee producing areas of Ethiopia were studied using the bounds test approach. While most of the literature on cointegration denotes arbitrage trade as a necessary condition for a market to integrate (Goodwin and Piggott, 2001; Ghoshray and Ghosh, 2011), the results of the models confirm that regional cointegration is possible. This is as a result of the trade of these regional markets with a common central market that also dispatches regular price information. The cointegration estimation shows that the direct trade restriction after the establishment of the ECX has affected the cointegration levels between the different regional coffee markets. However, the restriction has strengthened regional coffee market integration.

Q4. Has the establishment of the ECX created a harmonised cointegration of prices at regional coffee producers' markets?

The results of the ARDL model indicate that 21 of the 30 pairs of price series established a long-run cointegration relationship. Furthermore, the results suggest that between 2008 and 2013, the regional integration of producer markets appeared to be larger than national harmonisation. In addition, prices of the producer markets in

southern and south-western Ethiopia were more integrated. Another finding showed that an opportunity has been created for relatively lower quality coffee producing markets to establish a long-run, but limited, integration with higher quality coffee markets. Premium quality coffee markets, like those for Harar coffee, dominated the producer coffee market on establishing a long-run cointegration with coffees of other regions.

Since the direct trade restriction between the coffee growing areas became more stringent in the post-ECX period, it was hypothesised that price causality would be limited. However, no difference was found in the levels of price causality results between the two periods. In both of the analysed periods (before and after the establishment of the ECX), all 15 pairs of producer markets established a causality with their respective markets.

In sum, it was shown that spatially dispersed coffee markets integrate with each other, without direct trade between them, through trading on a central market. The ECX intended to create a single integrated Ethiopian coffee market, keeping the origin variation. However, the attempt was not enough to create a complete integration, rather an integration at the regional level was established.

The establishment of regional market integration was not surprising since coffee traders may serve coffee markets in the different regions. In other words, coffee of one region may be traded across the region's borders or, in some cases, may even change 'origin'. Such identification by origin is difficult to establish based on visual inspection of the coffee beans. Thus, the intensity and effects of cross-regional-border trade of coffee or by traders on price integration may be a subject for further investigation and research.

3. Examine the dynamic relationship between the world and the domestic markets for Ethiopian coffee after the introduction of the ECX

Q5. Has the price transmission along the coffee value chain changed for the different types of Ethiopian coffees?

This section of the doctoral thesis aimed to investigate how the establishment of the ECX impacted on the market integration and price transmission asymmetry between

different actors in the coffee value chain. The analysis was conducted for the five major types of Ethiopian coffee. Theoretically, the establishment of the ECX is considered a cornerstone in the creation of an institutionalised Ethiopian coffee market. The institutionalisation was put in place to overcome the major constraints observed in the coffee market, such as a lack of adequate market information, a lack of integration, a lack of transparency, high marketing costs and transaction costs, a lack of trust between buyers and sellers, collusion, and the dominance of exporters. Therefore, this study examined whether or not the ECX had succeeded in improving price transmission across the actors in the chain. A Nonlinear Autoregressive Distributed Lag model (NARDL), as proposed by Shin et al. (2014), was used to capture the asymmetric responses of the coffee producers, traders, and exporters to negative and positive price changes on the coffee markets, both in the short- and the long-run. Monthly price data at the producer, ECX, and export levels were analysed.

The findings suggest that there is a symmetric long- and short-run price transmission between producers and the ECX price, excluding Harar coffee. The tests further show asymmetric price relationships between producers and exporters of higher quality coffees (Harar, Sidama, and Yirgacheffe). This may be due to the market power of a small number of large companies at the export level. In addition, the ECX aimed to increase the number of exporters in order to enhance the competitiveness of the export market, yet the effects thereof are not yet visible in the studied prices.

Overall, the results show that there is a limited transmission of price increases at the ECX and export level to the producer level. However, frequent transmission towards producers is observed when there is a price decrease in the export market. Hence, producers continue to be price takers in the Ethiopian coffee market, and alternative measures to support them should guarantee that they could increase their bargaining power and benefit from the price information that is increasingly disseminated by the regional ECX offices.

Such measures to increase the bargaining power of producers could be subjects for further research. It may also be interesting to investigate the role that the ECX would play. The following section explains how de-commoditisation, as an alternative to the ECX market channel, could improve the small-scale farmers' welfare. However, the potential of other market support measures, within the ECX channel, to support farm gate prices should be investigated further.

4. Investigate the welfare impact of de-commoditisation on coffee producers marketing through membership of traceable coffee cooperatives

Q6. How well do farmers fare if they sell their coffee through certified-traceable cooperatives that are the alternative market channels to the ECX?

This research objective aimed to analyse the impact for farmers to market their coffee through certified cooperatives. This chain is an alternative to the ECX and makes the coffee traceable. Welfare and production data were compared between a group of farmers who were members of certified cooperatives and those who sold coffee through the ECX channel. Engagement in the certified and traceable coffee channels enabled producers to fetch a better and more stable price for their wet-processed coffee supply. However, this higher price was not sufficient to substantially increase coffee income. Furthermore, coffee yield was lower for members of certified cooperatives as compared to producers who sold to the ECX. One possible explanation for this finding is the relatively older age of the coffee trees on the farms of cooperative members.

The current study investigated if the variations in the intensity of participation in a traceable and certified coffee market made any difference. The subsequent results indicate that producers who are highly engaged in such markets are more inclined to provide cherries for wet processing to the cooperatives, which is ultimately demanded by the cooperative. These producers showed a tendency of specialising in coffee production by allocating most of their resources to coffee production. They also appeared to be less likely to be involved in the production of other crops. Generally, producers who were highly likely to be members of cooperatives tended to focus on achieving the criteria set by traceability and certification.

Two major challenges emerged from these findings. Firstly, while coffee sales through a certified cooperative seems to benefit farmers in terms of price stability, the impact on income is limited. Thus, the returns to investment in cooperative membership are questioned. Secondly, the volume of coffee traded through this alternative coffee chain is limited. Moreover, the share of coffee traded through the certified cooperatives is low compared to the trade on the ECX.

A further limitation of this research is that it was not possible to determine whether producers who sell coffee through a niche channel within the ECX would be better off as compared to the cooperative members. It may be beneficial for small-scale farmers to sell through the ECX channel to a particular exporter, as an alternative to the cooperative channel. Thus, this may be areas of interest for future research.

7.2 Major research contributions

Cointegration literature proposes a nonlinear cointegration framework to check market integration (Katrakilidis and Trachanas, 2012; Atil et al., 2014). However, the coffee price data used in this study did not fit the model specifications. Therefore, an appropriate linear cointegration model (Autoregressive Distributed Lag model) was used instead to test the integration of Ethiopian coffees with the international coffee market. This model confirms that data suitability needs to be tested for its fitness before jumping into complex modelling, which could lead to spurious results.

Previous studies (Milas et al., 2004, Ghoshray, 2009) on the export coffee price integration have considered the origin/ quality differences between the exporting countries and forwarded possible explanations for the levels of cointegration. This study explored the origin variation within Ethiopian coffees and examined the integration with the international coffee market prices. Thus, this study contributes to the existing literature by identifying how prices of different origin coffees from the same country integrate in the international coffee market.

Furthermore, the spatial integration section of this study investigated how spatially distant producer markets are integrated, even in the absence of direct trade between regional coffee markets. Previous studies that have investigated spatial integration without direct trade attributed the lack of trade between spatial markets to transaction costs (Fackler and Goodwin, 2001; Stephens et al., 2012). This study, however, is the first of its kind to explore price integration between coffee markets that do not trade with each other due to a policy restriction. Therefore, this study contributes towards filling a research gap by explaining that the establishment of spatial integration is possible, even in the absence of direct trade, if the regional markets are connected with the central market.

In addition, the price symmetry along the Ethiopian coffee value chain was explored in this study. Nonlinearity and asymmetry in the short- and long-run was examined with the use of the Nonlinear Autoregressive Distributed Lag model

(NARDL), as recently developed by Shin et al. (2014). As far as could be determined, this is the first study to apply the NARDL model in investigating price symmetry in African agriculture and food markets. Moreover, the current results explicitly portray the power of the NARDL model in explaining the dynamics of price symmetry in African markets.

Finally, the available literature on impact studies has been through continuous changes in order to accommodate identified limitations. The heterogeneity model, as developed by Xie et al. (2011), is one of the more recent impact analysis models to address the gap in knowledge with regards to self-selection bias. Currently, it is the first study in African agricultural markets to apply the model to investigate the heterogeneity impact of policy intervention at the farmer's level.

7.3 Policy recommendation

This doctoral study investigated the role of the ECX in the Ethiopian coffee market. It also assessed how the establishment of the ECX influenced price relationships between the Ethiopian and the international markets, between markets in coffee producing areas, and between different stakeholders in the coffee market. Furthermore, it analysed the impact of trading in an alternative market to the ECX. Based on the research findings, the following policies and strategies can be recommended.

The commoditisation at the ECX level remains a true challenge in order to fully grasp the benefits of possible niche market (high end) coffee. Even though, the commoditisation has a great advantage for low-value markets, the ECX could create a separate platform that would serve as a gateway for high quality coffees that, in turn, would warrant a better integration between producers and exporters. Furthermore, premium Ethiopian coffee did not cointegrate with Arabica coffee. This finding, however, does not pose a problem and may even be an advantage if the coffee is traded in high rewarding niche markets, and as long as the price changes at the export market transmits all the way down to the producer market. Thus, it is recommended that the ECX, the Ethiopian government, and sector strategies focus on supporting and incentivising stakeholders to actively participate in the increasingly important niche coffee markets.

The high-quality nature of most of the Ethiopian coffee is an advantage to exploit the higher-end markets. Yet, it is important to have more price differentiation and

quality premiums should be paid at the producer level. Producers should be able to benefit from their efforts to produce good quality coffee, which would ultimately motivate them to do so. In addition, traders should accept a differentiated supply from the producers, and should not buy in bulk.

Moreover, the ECX could play an important role by facilitating quality enhancement programmes focusing on both high-end and lower quality coffee types. Such an endeavour may attract the support of international institutions who wish to invest in quality improvements in a unilateral or multilateral manner.

In addition, addressing the lack of proper and functional grades and standards for coffees transacted at the producer level is critical if the sector intends to increase prices at the producer level. Producers are price takers as they sell their coffee to a limited number of traders and cooperatives operating at the producer level, who usually are the ones determining the quality and the price. Establishing a grading and inspection centre closer to the farm gate level would encourage producers to differentiate coffee quality and enhance the market transparency along the value chain. The establishment of such grading labs has previously been successful in cooperatives supported by USAID in southern Ethiopia.

Furthermore, it may be suggested that efforts to enhance the quality of the coffee produced in different growing areas of Ethiopia may foster the harmonisation of the national market integration (creating a single Ethiopian coffee market) alongside capturing the benefits of origin-based coffee trade. Most of the coffee growing regions are located in the Ethiopian highlands and are relatively close to each other. Thus, it may be more difficult to strengthen price causalities between the more distant producer markets. However, this may only be beneficial if a sufficiently reliable system is in place that improves price cointegration between markets as well as enables origin labelling.

The high price to be paid for a membership seat in the ECX also serves as a filtering mechanism, in which only financially strong exporters enter the ECX, which paves the way for collusion. Again, solely increasing the number of exporters does not guarantee competitiveness at the export market, nor does it improve the transmission of prices to the local markets. Therefore, it could be suggested that the ECX develops and implements an effective pricing scheme so that competitiveness at the level of the exporters within the ECX could be enhanced.

Previously, the ECX had made two attempts at improving the traceability of coffee through the establishment of Direct Specialty Trade (DST) in 2010 and the tagging system, both of which failed. The tagging system failed in 2015 due to a lack of trust between the coffee traders and the government. This is an indication that the ECX is not the most convenient institution to execute traceability. Furthermore, the availability of donor supported traceable systems for a small segment of the coffee producers that are marketing through cooperatives cannot guarantee a sustainable supply of traceable coffee to the international market. Thus, the cooperative traceability system should be internalised in the government cooperative system and not should depend on the certification systems only. In addition, since the commoditisation process along the coffee value chain influences the predictability of the price movement and widens the price gap between producers and traders, policy instruments that promote de-commoditisation have the power to mitigate such problems.

Furthermore, market transparency through the provision of market information at the producer level alone is not sufficient to empower the coffee producers. The financial bargaining position of producers could thus be enhanced through supporting producers' associations, which are subsequently serving as a market outlet. Moreover, supporting individual coffee producers at the farm level was not and is still not a cost-effective way for an agrarian based economy.

The relatively higher coffee price received by producers marketing through traceable and certified cooperatives could also not secure a higher income. This leads us towards the root problem of lower yields per hectare. Since replacing the aging tree stock with a new and improved variety takes time, during which no harvest is possible, stakeholders could grant producers a long-term loan to smooth out the financial gap until the new trees mature. In this regard, the recent work of root capital rehabilitation and renovations in Nicaragua, Peru, Mexico, and Honduras serves as a successful example for replacing the aging coffee trees. Moreover, the Colombian government, in partnership with the Federación Nacional de Cafeteros de Colombia renovation programme, is another success story that could be adopted (Rootcapital, 2016).

Another particularly important issue that still deserves our attention is the sustainable use of water during wet processing of coffee. Wet-processed coffee is high in demand in the international coffee market, which forces cooperatives and private suppliers to expand their washing stations. Thus, the issue of sustainable use of the

water and treating the waste water deserves due attention. Alternative washing stations could drastically reduce the need for water. Therefore, internalising the sustainability issue in the licensing procedure of cooperatives and private washing stations could be a feasible recommendation. In addition, the introduction of ecosystem services payment schemes could enhance the well-being of the coffee farmers, and subsequently protect the ever-increasing threat posed by global climate changes on the coffee growing regions of Ethiopia.

7.4 Limitation and further study

Even though this doctoral study provided insights into the dynamics of the Ethiopian coffee market after the establishment of the ECX, there is a need for further research. For example, this study relies on the time series data obtained to explain the dynamics of the Ethiopian coffee market. However, the current situation could not be determined since the most recent data were not used.

It is also important to acknowledge that other factors that may have influenced price cointegration during the time periods under study were not accounted for. For instance, the improved flow of information may have resulted from an increased use of mobile phones. It is likely that such improved lines of communication amplified the impact of the ECX information services, however, it was not possible to quantify this effect due to a lack of data.

Furthermore, the current results show a complete lack of long- and short-run price transmission between the producer and the ECX, except for Harar coffee which appears to have short-run price asymmetry. Such a lack of transmission could emanate from the increased market power of the coffee traders, but this still needs to be further investigated. The lack of price transmission may also be due to operational inefficiency in the value chain, which was not investigated in the current study. Moreover, the amount of data used to study price transmission and cointegration was relatively small. It is therefore believed that a longer period of price data could provide even more insights into the Ethiopian coffee market.

Finally, the score of this doctoral thesis was to enlighten the impact of the 2008 Ethiopian market policy reform on the performance of the coffee sector and more specifically the contribution of ECX towards achieving the anticipated goals. Further

studies focusing on longer period of price data and taking the different macroeconomic variables into consideration are recommended.

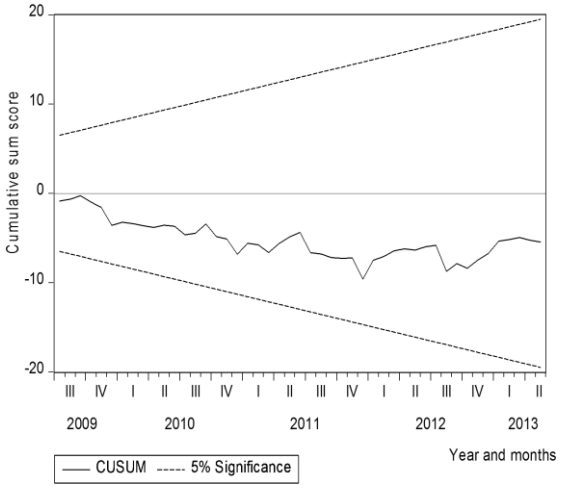
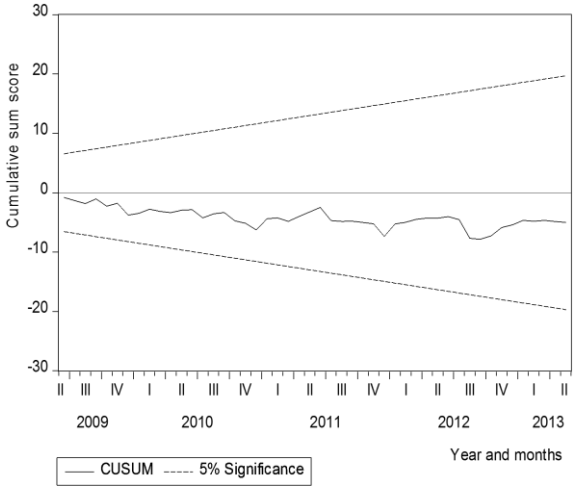
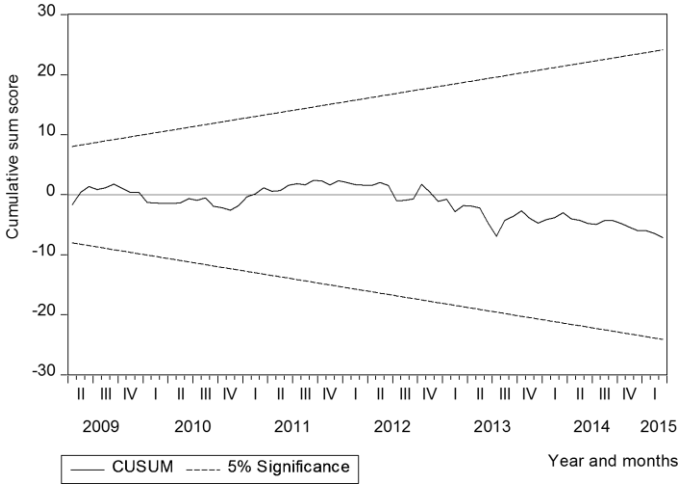
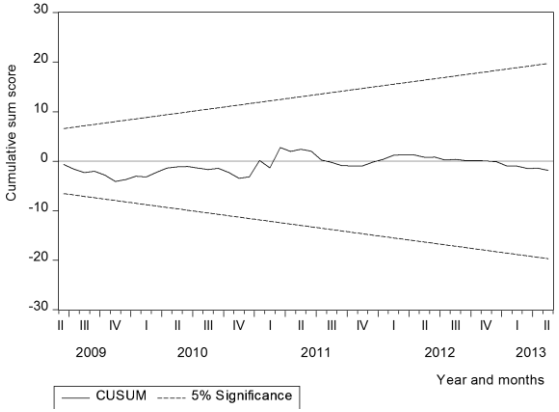
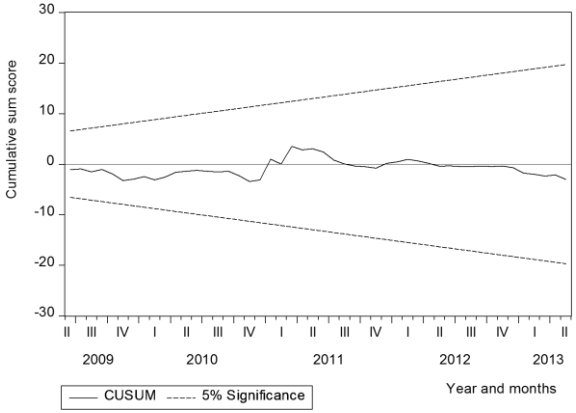
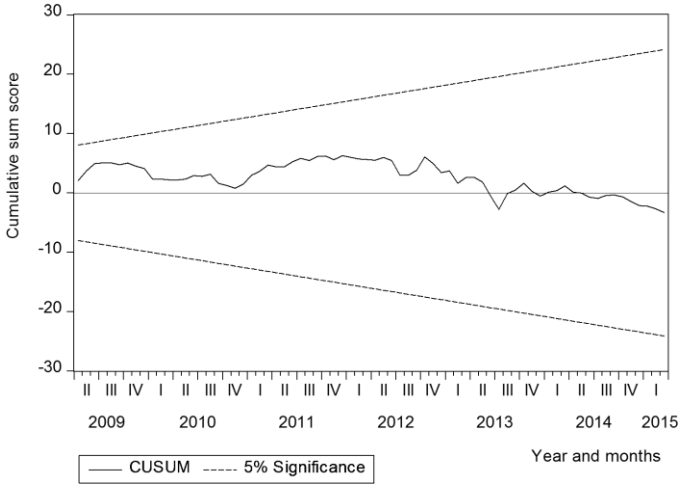
Appendices

Appendix I: Nonlinear cointegration test results (NARDL) of prices of Ethiopian coffees with prices of coffees on the international market

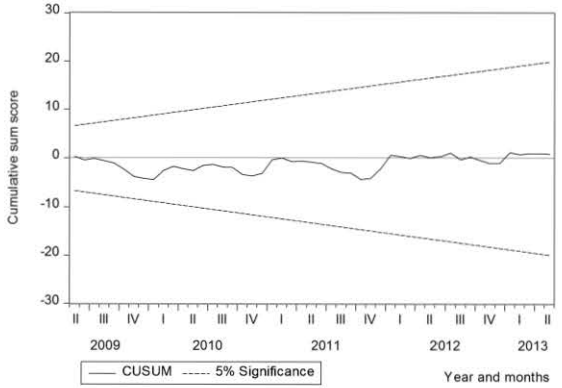
Ethiopian coffee	Coffee type	NARDL	
		Pre-ECX	Post-ECX
Yirgachefe	Robusta	3.23	2.35
	Other Milds	3.10	1.14
	Colombian	3.18	2.37
	Brazilian	2.73	2.29
Jimma	Robusta	1.70	6.60
	Other Milds	0.80	0.63
	Colombian	0.99	2.09
	Brazilian	0.92	0.97
Sidama	Robusta	1.58	2.36
	Other Milds	1.58	1.62
	Colombian	1.29	1.36
	Brazilian	2.99	1.16
Harar	Robusta	0.25	1.34
	Other Milds	0.95	2.33
	Colombian	1.04	0.33
	Brazilian	0.97	0.32

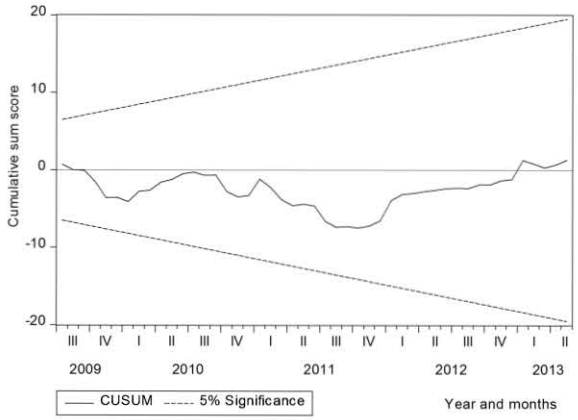
Note: 7.84, 5.73, and 4.78 are the critical F statistic values for NARDL at the 1%, 5%, and 10% levels, respectively.

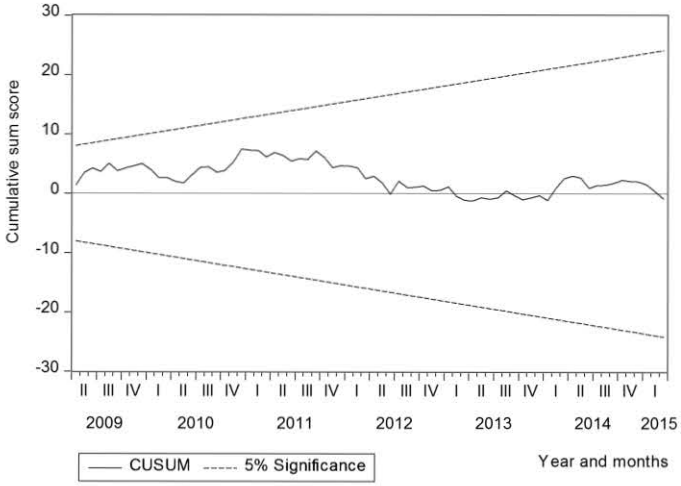
Appendix II: CUSUM Test

	Producer-ECX	Producer-export	ECX-export
Harar			
Jimma			

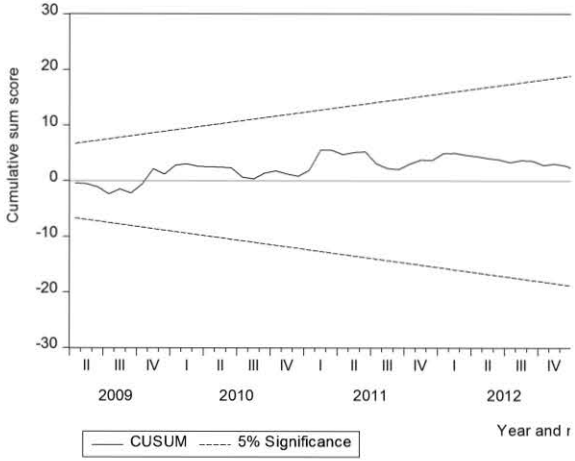
Sidama

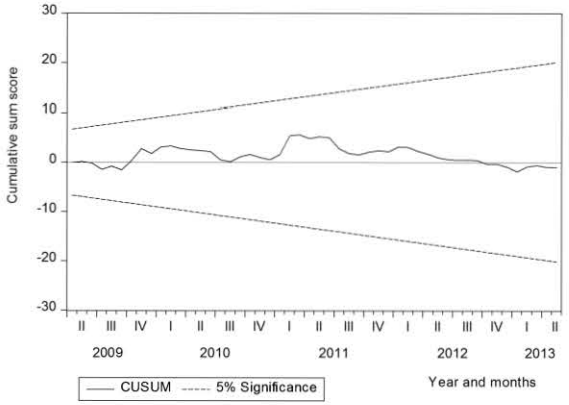


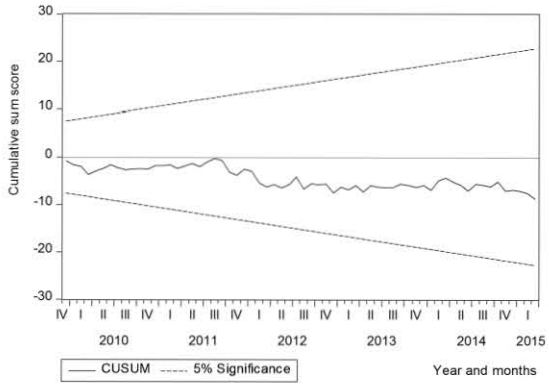




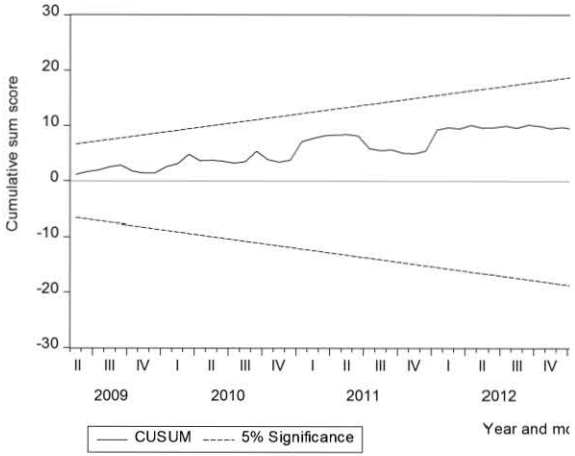
Wollega

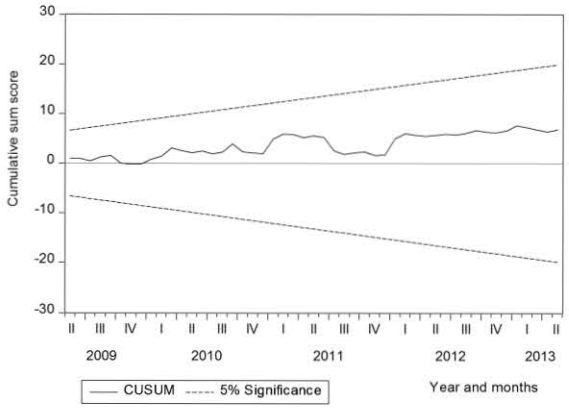


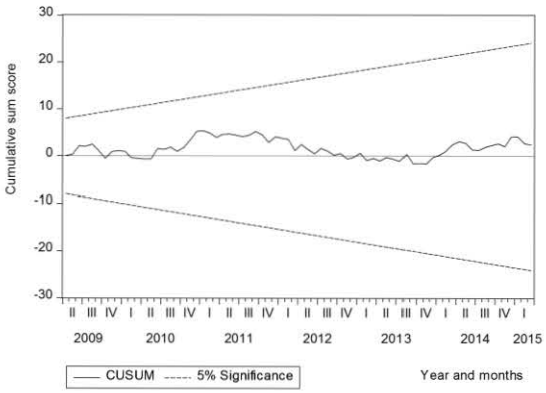




Yirgacheffe

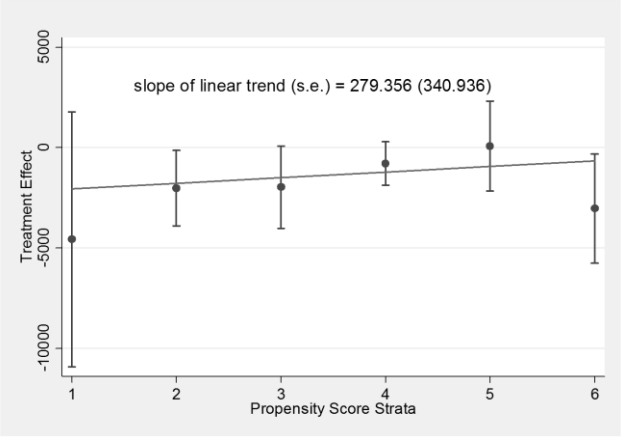




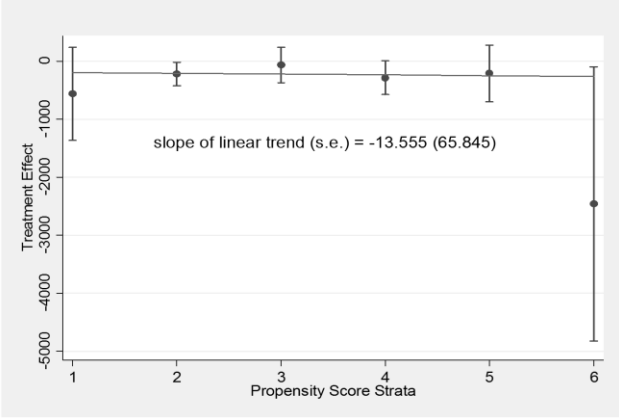


Appendix III: Stratification-Multilevel (SM) Heterogeneous traceable effects

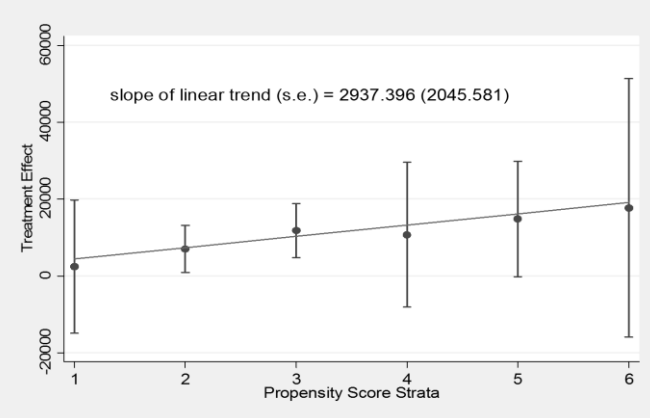
Coffee yield



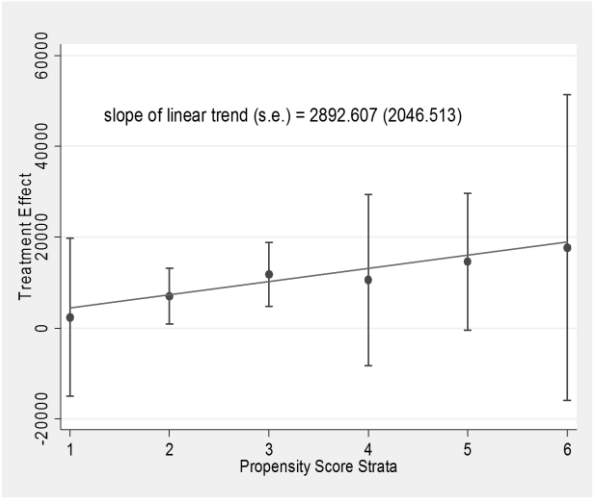
Dry-processed coffee production



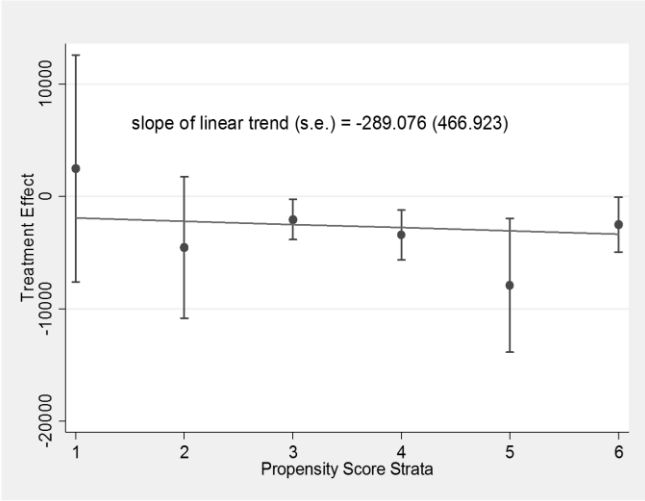
Asset after 2010



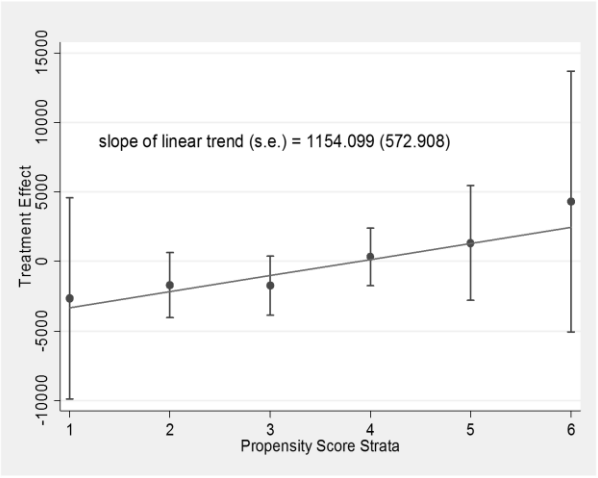
Durable asset



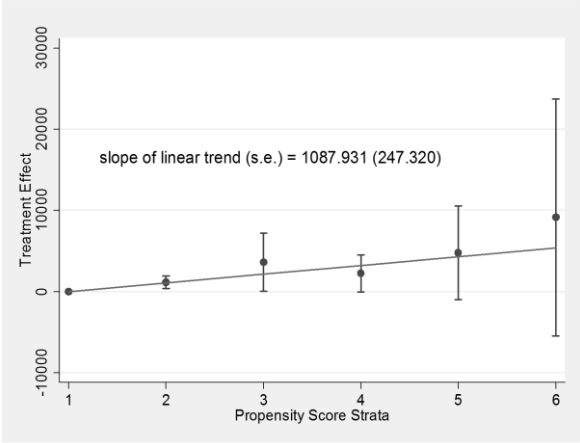
Income from other crops



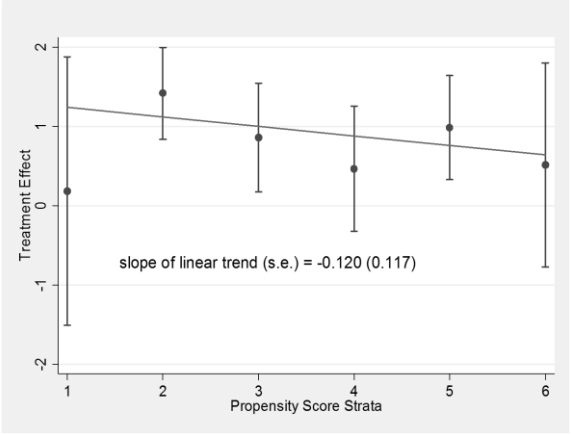
Non-farm income



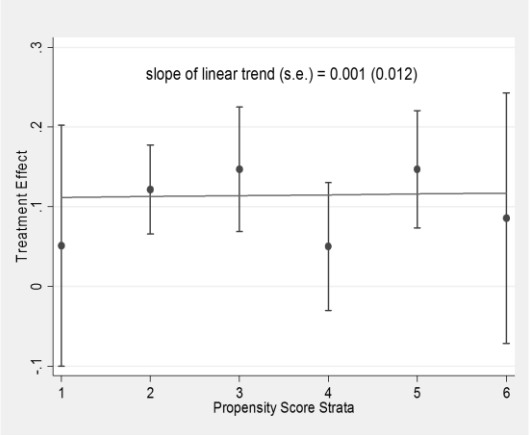
Saving



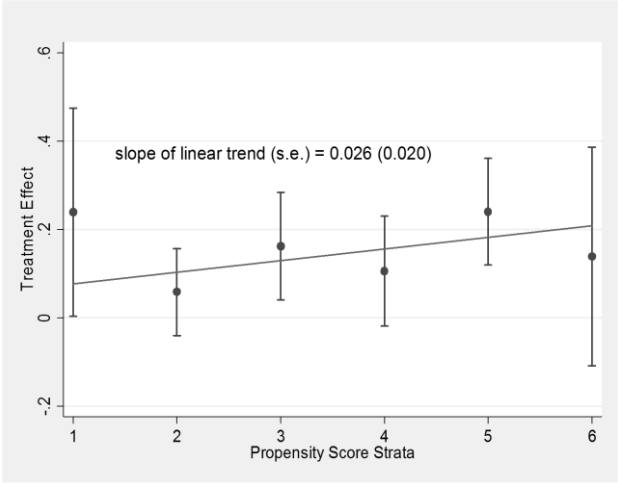
Organisational trust



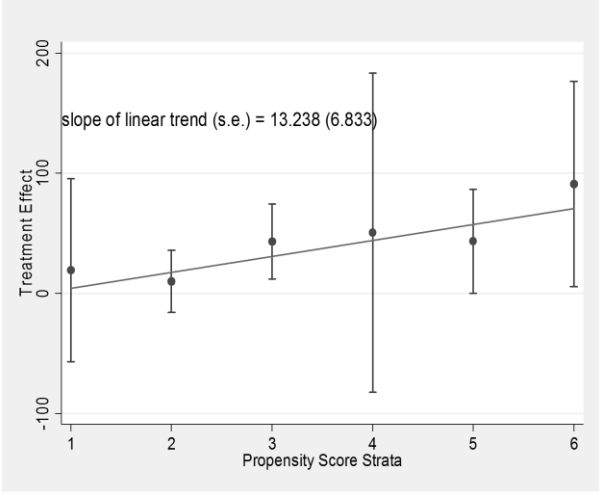
Organisational membership



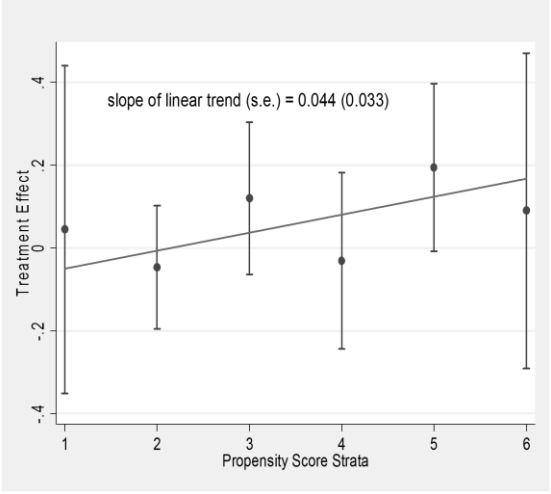
Practice land conservation



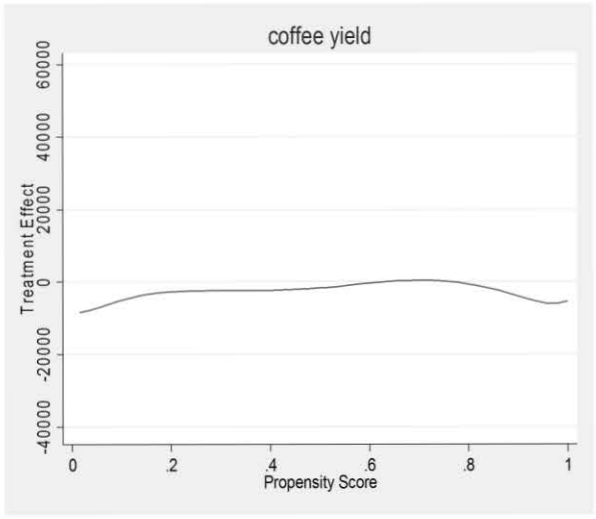
Tree planted

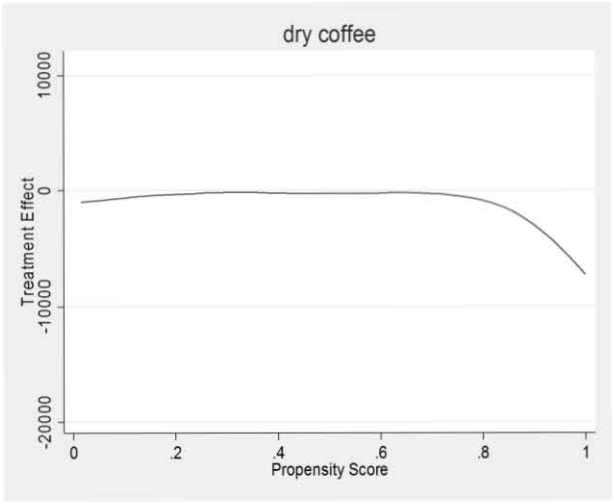


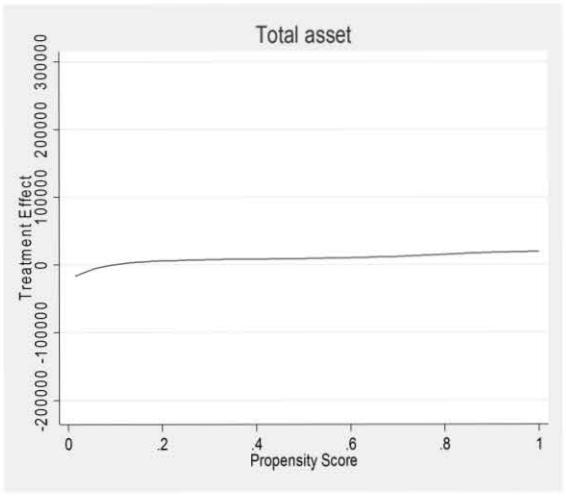
Organic fertiliser

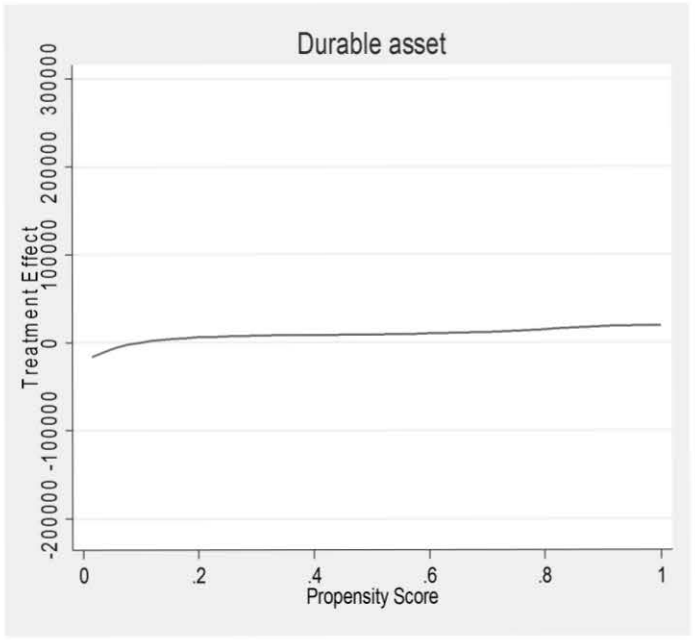


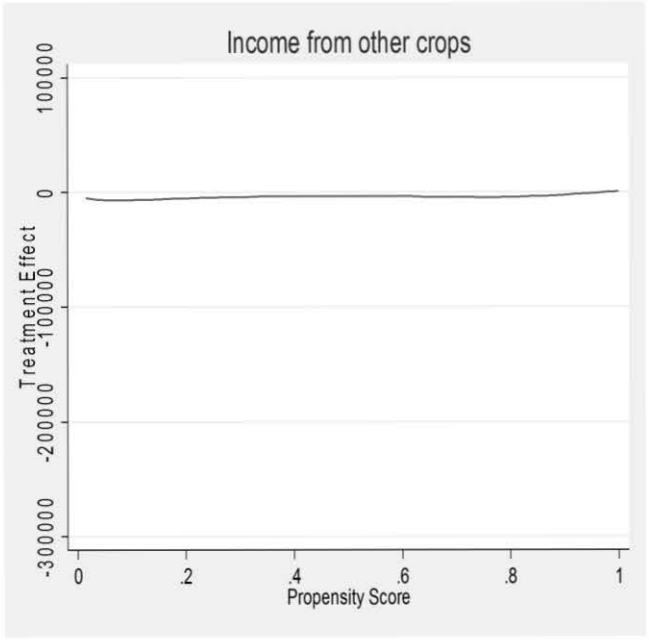
Appendix IV: Matching-Smoothing (MS) Heterogeneous certification and traceability effect

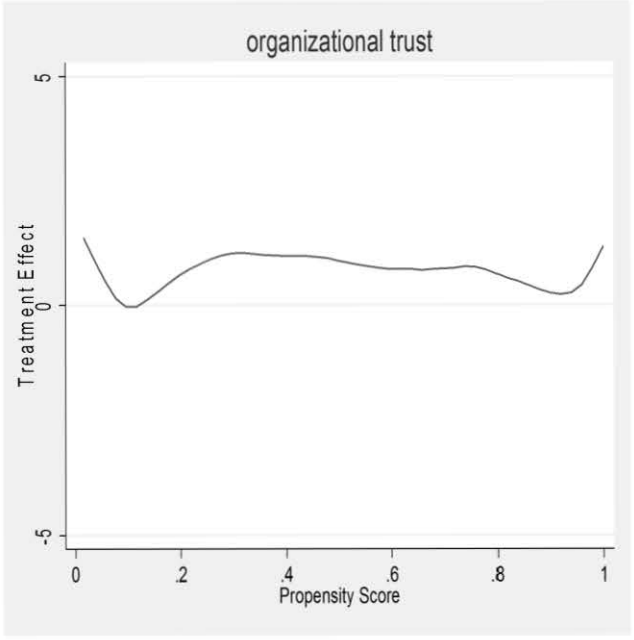


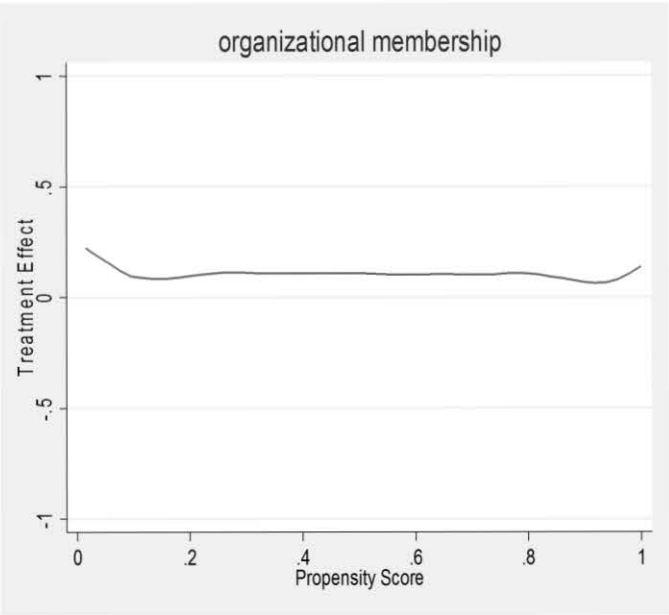


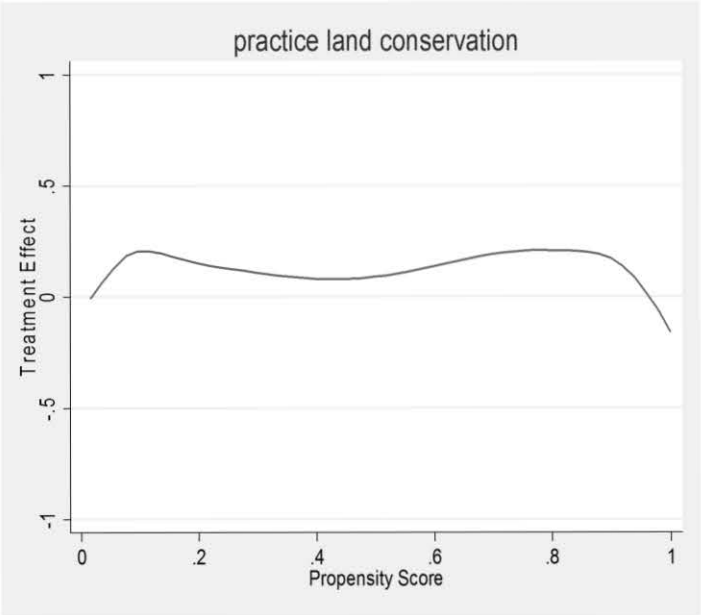









organizational membership
Treatment Effect
-1
-.5
0
.5
1
0
.2
.4
.6
.8
1
Propensity Score


practice land conservation
Treatment Effect
-1
-.5
0
.5
1
0
.2
.4
.6
.8
1
Propensity Score

Appendix V: Balancing tests of matched samples

Variable	Unmatched Matched	Mean		% bias	%reduction bias	p>|t|
		Treated	Control			
Sex of the household head (0=male,1= female)	Unmatched	0.076	0.051	10.2		0.202
	Matched	0.077	0.084	-2.8	72.6	0.776
Age of the household head (number)	Unmatched	45.01	43.85	10.1		0.210
	Matched	44.919	45.44	-4.6	54.6	0.607
Education level of the household head (number)	Unmatched	4.674	3.11	52.5		0.000*
	Matched	4.48	4.66	-6.0	88.6	0.515
Asset value until 2009 (number)	Unmatched	53147	36748	25.4		0.001*
	Matched	47466	50114	-4.1	83.8	0.585
Dependency ratio (number)	Unmatched	0.377	0.366	4.6		0.572
	Matched	0.380	0.369	4.6	-0.2	0.602
Years of experience in coffee farming (number)	Unmatched	17.73	16.57	12.6		0.116
	Matched	17.47	17.94	-5.0	60.1	0.566
Family size (number)	Unmatched	5.67	5.09	27.1		0.001*
	Matched	5.55	5.62	-3.3	88.0	0.720
Radio ownership (1= yes, 0= no)	Unmatched	0.830	0.68	33.4		0.000*
	Matched	0.818	0.822	-1.0	97.0	0.899
Coffee area (ha) in 2010	Unmatched	1.056	0.77	35.2		0.000*
	Matched	0.941	0.970	-3.6	89.9	0.664
Other crop area (ha) in 2010	Unmatched	0.833	0.959	-16.6		0.040**
	Matched	0.810	0.839	-3.7	77.5	0.617
Distance to the market (in km)	Unmatched	4.10	4.44	-6.3		0.425
	Matched	4.10	4.26	-3.1	51.4	0.719
Distance to the credit institution (in km)	Unmatched	22.90	12.43	37.0		0.000*
	Matched	14.91	12.62	8.1	78.1	0.162
Extension contact (in number)	Unmatched	3.56	3.388	9.1		0.261
	Matched	3.43	3.389	2.4	73.5	0.783
District (0 = Jimma, 1= Kaffa)	Unmatched	0.61	0.77	-35.4		0.00
	Matched	0.59	0.59	-10.8	98.0	0.94

Reference

Abasanbi, A., 2010. Assessment of Coffee Quality and Its Related Problems in Jimma Zone of Oromia Regional State. Master Thesis Submitted to the School of Graduate Studies of Jimma University, College of Agriculture and Veterinary Medicines, Jimma University, Jimma.

Abdulai, A., 2007. Spatial and Vertical price transmission in food staples market chains in Eastern and Southern Africa: What is the evidence? Paper presented at the FAO Trade and Markets Division Workshop on Staple Food Trade and Market Policy Options for Promoting Development in Eastern and Southern Africa, Rome.

Abebaw, D., Haile, M.G., 2013. The impact of cooperatives on agricultural technology adoption: empirical evidence from Ethiopia. Food Policy, 38, 82–91.

Adinew, G., 2011. The Impact of the Ethiopian Commodity Exchange on Coffee Marketing: A Case of Eastern Ethiopia. A Case Study Report. Haramaya University School and Agricultural Economics and Agribusiness.

Adugna, G., Bellachew, B., Shimber, T., Taye, E., Kufa, T., 2008. Coffee diversity & knowledge, Ethiopian Institute of Agricultural Research, Addis Ababa, Ethiopia: 317-227.

Akiyama, T., Baffes, J., Larson, D.F., Varangis, P., 2003. Commodity Market Reform in Africa: Some Recent Experience. Economic Systems, 27(1), 83-115.

Alam, M.J., McKenzie, A.M., Buysse, J., Begum, I.A., Wailes, E.J., Van Huylenbroeck, G., 2012. Measuring Market Integration in the Presence of Threshold Effect: The Case of Bangladesh Rice Markets. Selected Paper prepared for presentation at the Agricultural & Applied Economics Association`s 2012 AAEA Conference, Seattle, Washington, USA.

Alemu, D., Meijerink, G., 2010. The Ethiopian Commodity Exchange: An Overview. Ethiopian Pulses, Oilseeds and Spices Processors Exporters Association and Wageningen University.

Alemu, M., 2015. Coffee Seed Production and Supply at Research Centre in Ethiopia. World Journal of Biology and Medical Sciences, Volume 2, Issue- 4, 82-88.

Alemu, Z.G., Worako, T.K., 2011. Producer price and price transmission in a deregulated Ethiopian coffee market. Agrekon, 50(2), 27-40.

Alexander, C., Wyeth, J., 1994. Cointegration and market integration: an application to the Indonesian rice market. Journal of Development Studies, 30 (2), 303–328.

Allison, M., 2009. Coffee-trade Switch in Ethiopia Disappoints Importers. The Seattle Times, 3 April. Available from: http://seattletimes.com/html/business technology /2008976281 _ ethi opia 03.html.

Amsalu, A., Ludi, E., 2010. The Effect of Global Coffee Price Changes on Rural Livelihoods and Natural Resource Management in Ethiopia A Case Study from Jimma Area. Retrieved from http://www.north-south.unibe.ch/content.

Ang, J., 2007. CO2 emissions, energy consumption, and output in France. Energy Policy, 35(10), 4772– 4778.

Arslan, A., Reicher, C., 2010. The Effect of the Coffee Trademarking Initiative and Starbucks Publicity on Export Prices of Ethiopian Coffee. Working paper No. 1606, Kiel Institute, March. Available from: http://www.ifw-members.ifw-kiel.de/ publications/the-effects-of-the-coffee-trademarking-initiative-and-starbucks-publicity-on-export-prices-of-ethiopian -coffee-1/kwp-1606.pdf

Asche, F., Bremnes, H., Wessells, C. R., 1999. Product aggregation, market integration and relationships between prices: an application to world salmon markets. American Journal of Agricultural Economics, 81(3), 568–581.

Atil, A., Lahiani, A., Nguyen, D.K., 2014. Asymmetric and nonlinear pass-through of crude oil prices to gasoline and natural gas prices. Energy Policy, 65, 567–573.
Awokuse, T.O., 2007. Market reforms, spatial price dynamics, and China's rice market integration: A causal analysis with directed acyclic graphs. Journal of Agricultural and Resource Economics, 32(1), 58–76.
Barham, B.L., Weber, J.G., 2012. The economic sustainability of certified coffee: Recent evidence from Mexico and Peru. World Development, 40 (6), 1269–1279.
Barrett, C.B., Li, J. R., 2002. Distinguishing between equilibrium and integration in spatial price analysis. American Journal of Agricultural Economics, 84(2), 292-307.
Bartlett, J.E., Kotrlik, J.W., Higgins, C.C., 2001. Organizational Research: Determining Appropriate Sample Size in Survey Research. Information Technology, Learning, and Performance Journal, Vol 19(1): 43-50.
Baser, O., 2006. Too much ado about propensity score models? Comparing methods of propensity score matching. Value in Health. 9:377–385.
Baulch, B., 1997a. Transfer cost, spatial arbitrage, and testing for food market integration. American Journal of Agricultural Economics, 79(2), 477-487.
Baulch, B., 1997b. Testing for Food Market Integration Revisited. Journal of Development Studies, 33, 512–34.
Benedetto, R., Romano, D., Raid, H., 2013. Agriculture reform and food crisis in Syria: Impacts on poverty and inequality. Food policy, 43, 190-203.
Bernard, T., Gabre-Madhin, E., Tafesse, A.S., 2007. Smallholders' commercialization through cooperatives: A diagnostic for Ethiopia. IFPRI Discussion Paper 722. IFPRI (International Food Policy Research Institute), Washington, DC, USA.
Bernard, T., Taffesse, A.S., Gabre-Madhin, E., 2008. Impact of cooperatives on smallholders' commercialization behavior: evidence from Ethiopia. Agric. Econ., 39, 147–161.
Bjerga, A., Patton, L., 2011. Ethiopia's Starbucks Rivals Avoid Ethiopian Coffee as Beans Lose Cachet. Bloomberg, 1 Sept. Available at: http://www.bloomberg.com/news/2011-09-01/starbucks-rivals-reject-ethiopian-coffee-as-bean-cachet-withers.html.
Blyn, G., 1973. Price Series Correlation as a Measure of Market Integration. Indian Journal of Agricultural Economy, 28(2), 56-90.
Boot, J.W., 2011. Ethiopian Coffee Buying Manual. Practical Guidelines for the Purchasing and Importing of Ethiopian Specialty Coffee Beans.
Brand, J.E., Davis, D., 2011. The Impact of College Education on Fertility: Evidence for Heterogeneous Effects. Demography, 48(3), 863-887.
Brand, J.E., Simon, Thomas J., 2013. "Causal Effect Heterogeneity". Pp. 189–214 in Handbook of Causal Analysis for Social Research, edited by Stephen L. Morgan. New York: Springer.
Bryson, J.M., Cunningham, G.L., Lokkesmoe, K.J., 2002. What to do when stakeholders matter: the case of problem formulation for the African American men project of Hennepin county, Minnesota. Public Administration Review 62, 568-584.
Buhr, B.L., 2003. Traceability and information technology in the meat supply chain. Journal of Food Distribution Research, 34 (3), 13–26.
Caliendo, M., Kopeinig, S., 2008. Some practical guidance for the implementation of propensity score matching. Journal of Economic Surveys, 22 (1), 31–72.
Cashin, P., McDermott, C.J., Scott, A., 1999. The myth of co-moving commodity price. IMF Working paper 99/169. Washington DC: International Monetary Fund.

Celeste Aida, M. F., 2010. Trading Coffee through the Ethiopia Commodity Exchange: Social Embeddedness and Performativity of markets; Partial Fulfillment of the Requirements for the Masters of Arts in Development Study, Netherlands, 2010.

Central Statistics Agency, 2014. Population and housing census, statistical abstract, Addis Ababa, Ethiopia.

Chernet, T., 2008. Land Resources and socio-economic report of Bonga, Boginda, Mankira and the surrounding areas in Kaffa zone, SNNPRS, Ethiopia. Report for PPP project on the establishment of a Coffee Biosphere Reserve in Bonga Region. Addis Ababa, Ethiopia.

Chiputwa, B., Spielman, D.J., Qaim, M., 2015. Food standards, certification, and poverty among coffee farmers in Uganda. World Development, 66 (1), 400–412.

Delgado, C.L., 1986. A variance components approach to food grain market integration in Northern Nigeria. American *Journal* of Agricultural *Economics*, 68(4), 970–979.

Dennis, R., 2007. Literature Survey on biological data Bonga, Boginda and Mankira Forest, Kafa, Ethiopia. and research carried out in Bonga area, Kafa, Addis Ababa, Submitted to PPP Project, pp: 9-10. Ethiopia, pp: 5-8.

Dercon, S., 1995. On Market Integration and Liberalization: Method and Application to Ethiopia. Journal of Development Studies, 32(1), 112-43.

Dickey, D.A., Fuller, W.A., 1981. Distribution of the estimators for autoregressive time series with a unit root. Econometrica, 49, 1057-72.

Donovan, J., Poole, N., 2014. Changing asset endowments and smallholder participation in higher value markets: Evidence from certified coffee producers in Nicaragua. Food Policy, 44, 1–13.

Ellis, F., 1992. Agricultural policies in developing countries, Cambridge, Cambridge University Press.

Ellis, F., 2000. Rural Livelihoods and Diversity in Developing Countries, Oxford: Oxford University Press.

Emran, M.H., Shilip, F., Alam, M.I., 2007. Economic liberalization and price response of aggregate private investment, time series evidence from India. Canadian Journal of Economics, 40(3), 914–934.

Engle, R.F.,1982. Autoregressive conditional hetero skedasticity with estimates of the variance of United Kingdom inflation. Econometrica 50, 987–1007.

Engle, R.F., Granger, C.W.J., 1987. Cointegration and Error Correction: Representation , Estimation and Testing. Econometrica, 55(2), 251-276.

Ethiopian Coffee Exporters Association (ECEA), 2013. Coffee export marketing in Ethiopia. Annual report. Addis Ababa.

Ethiopia Commodity Exchange (ECX), 2008. What is in A Bean? ECX and Specialty Coffee Market.

Ethiopia Commodity Exchange (ECX), 2009. Company profile. Retrieved from http://www.ecx.com.et/CompanyProfile.aspx

Ethiopia Commodity Exchange (ECX), 2010a. Retrieved from<http://www.ecx.com.et/>.

Ethiopian Commodity Exchange (ECX), 2010b. ECX Direct Specialty Trade (DST). Available at: http://www.ecx.com.et/downloads/contracts/Coffee/CoffeeContracts .pdf

Ethiopia Commodity Exchange (ECX), 2015. Ethiopia Commodity Exchange Coffee Contract. Retrieved from http://www.ecx.com.et/downloads/Contracts/Coffee/ CoffeeContracts.pdf

Fackler, P.L., Goodwin, B.K., 2001. Spatial price analysis. In Handbook of Agricultural Economics, vol. 1B, ed. B. Gardner and G. Rausser, 971-1024, Amsterdam: Elsevier Science.

Fackler, P.L., Tastan, H., 2008. Estimating the Degree of Market Integration. American Journal of Agricultural Economics, 90(1), 69-85.
Fafchamps, M., Hill, R.V., 2007. Price transmission and trader entry in domestic commodity markets. Economic Development and Cultural Change, 56(4), 729-766.
Fousekis, P., 2015. Spatial price transmission in major EU pig meat markets: An Empirical Investigation with a Non Parametric Approach. International Journal of Applied Economics, 12(1), 108-122.
Fousekis, P., Katrakilidis, C., Trachanas, E., 2016. Vertical price transmission in the US beef sector: Evidence from the nonlinear ARDL model. Economic Modelling, 52, 499-506.
Frenette, B., 2010. The Grind: Ethiopian Coffee Finds Its Way. National Post, 23 Sept. Available at: http://life.nationalpost.com/2010/09/23/the-grind-ethopian-coffee-finds-its-way/.
Fry, J.M., Lai, B., Rhodes, M., 2011. The interdependence of coffee spot and futures markets. International network for economic research Working Paper Series.1. Available at http://www.inferresearch.net/files_ publications fry%20et /%20al.%20 INFER% 20 WP% 202011.1.pdf.
Gabre-Madhin, E., 2012. *A market for Abdu: Creating a commodity exchange in Ethiopia.* Intl Food Policy Res Inst, 2012.
Gabre-Madhin, E., Goggin, I., 2005. Does Ethiopia need a Commodity Exchange? An integrated approach to market development. EDRI-ESSP Policy Working Papers (p.26), Washington D.C.: IFPRI.
Gebreselassie, S., Ludi, E., 2008. Agricultural Commercialization in Coffee Growing Areas of Ethiopia, Future Agriculture, University of Sussex, Brighton, UK, available at: http://r4d.dfid.gov.uk/PDF/ Outputs/Futureagriculture/coffee_paper.pdf.
Gellynck, X., Verbeke, W., 2001. Consumer perception of traceability in the meat chain. Agrarwirtschaft, 50 (6), 368–374.
Gemech, F., Struthers, J., 2007. Coffee Price Volatility in Ethiopia: Effects of Market Reform Programmes. Journal of International Development, 19(8), 1131–42.
Getnet, K., 2008. From market liberalization to market development: The need for market institutions in Ethiopia. Economic Systems, 32(3), 239–252.
Getnet, K., 2007. Spatial equilibrium of wheat markets in Ethiopia. African Development Review. 19(2), 281–303.
Getnet, K., Verbeke, W., Viaene, J. 2005. Modeling spatial price transmission in the grain markets of Ethiopia with an application of ARDL approach to white teff. Agricultural Economics, 33, 491–502. DOI: 10.1111/j.1574-0864.2005.00469.x
Ghoshray, A., 2009. On Price Dynamics for Different Qualities of Coffee. Review of Market Integration, 1 (1), 103-118.
Ghoshray, A., Ghosh, M., 2011. How Integrated is the Indian Wheat Market?, Journal of Development Studies, 47(10), 1574-1594.
Giles, J.A., Mizra, S., 1998. Some pretesting issues on testing for Granger non - causality. Econometric Working Papers, EWP9914, Department of Economics, University of Victoria, Canada.
Goletti, F., Ahmed, R., Farid, N., 1995. Structural Determinants of Market Integration: The Case of Rice Markets in Bangladesh. Developing Economies, 33, 185–202.
Gonzalez-Rivera, G., Helfand., S.M., 2001. The extent, pattern, and degree of market integration: a multivariate approach for the Brazilian rice market. American Journal of Agricultural Economics, 83(3), 576-92.
Goodwin, B.K., Piggot, N., 2001. Spatial market integration in the presence of threshold effects, American Journal of Agricultural Economics, 83(2), 302-317.

Granger, C.W.J., Newbold, P., 1974. Spurious Regression in Econometrics. Journal of Econometrics, 2(2), 111-20.
Greenwood-Nimmo, M.J., Shin, Y., 2013. Taxation and the Asymmetric Adjustment of Selected Retail Energy Prices in the UK. Economics Letters 121(3), 411-416.
Hamza, A., Azenaw, T., 1995. Structural adjustment policy and Ethiopian agriculture: an assessment of short- run response and structural problems. Proceedings of the fourth annual conference on the Ethiopian economy, Addis Ababa.
Hanmer, L., Nashold, F., 2000. Attaining the international development targets: Will growth be enough?' Development Policy Review, 18(1), 11-36.
Harriss, B., 1979. There is Method in My Madness: Or is it vice versa? Measuring Agricultural Market Performance. Food Research Institute Studies, 17(2), 197-218.
Heckman, J.J., Ichimura, H., Todd, P.E., 1997. Matching as an econometric evaluation estimator: Evidence from evaluating a job training program. Review of Economics Studies, 64(4), 605-654.
Hernandez, M.A., Rashid, S., Solomon, L., Kuma, T., 2015. Institutions and Market Integration: The Case of Coffee in the Ethiopian Commodity Exchange. IFPRI Discussion Paper 1464.
International Food Policy Research Institute (IFPRI), 2003. Getting markets right: an institutional and legal analysis of grain and coffee marketing in Ethiopia. New York: IFPRI.
International Coffee Organization (ICO), 2014a. World coffee trade (1963 – 2013): A review of the markets, challenges and opportunities facing the sector. International Coffee Council 112th Session 3 – 7 London, United Kingdom.
International Coffee Organization (ICO), 2014b. Monthly coffee report (March). Retrieved from http://dev.ico.org/documents/cy2013.
International Coffee Organization (ICO), 2014c. Coffee consumption in East and Southeast Asia: 1990 – 2012. Retrieved from http://www.ico.org/news/icc.
International Coffee Organization (ICO), 2016. Trade statstics table. Retrieved from http://www.ico.org/trade_statstics.asp.
Ismet, M., Barkley, A.P., Llewelyn, R.V., 1998. Government Intervention and Market Integration in Indonesian Rice Markets, Agricultural Economics, 19(3), 283-295.
International Organization for Standardization(ISO), 2000. International Standard ISO 9000: Quality management systems Fundamentals and vocabulary.
Jaffry, S., 2005. Asymmetric Price Transmission: A Case Study of the French Hake Value Chain. Marine Resource Economics 19(4), 511-523.
Jammazi, R., Lahiani, A., Nguyen, D., 2015. A wavelet-based nonlinear ARDL model for assessing the exchange rate pass-through to crude oil prices. Journal of International Financial Markets, Institutions and Money, 34, 173-187.
Jena, P.R., Stellmacher, T., Grote, U., 2012. The Impact of Coffee Certification on Small-Scale Producers Livelihoods: Evidence from Ethiopia. International Association of Agricultural Economists (IAAE) Conference, Foz do Iguaçu, Brazil, August, 2012. Available at: http://tinyurl.com/kwal37d.
Jensen, R., 2007. The Digital Provide: Information, Market Performance, and Welfare in the South Indian Fisheries Sector. The Quarterly Journal of Economics, 122(3), 879-924.
Johansen, S., Juselius, K., 1988. Hypothesis Testing for Cointegration Vectors-With an Application to the Demand for Money in Denmark and Finland, Preprint University of Copenhagen.
Jones, W.O., 1973. Marketing Staple Food Crops in Tropical Africa. The Economic Journal, 83 (332), 1326-1328.

Kamau, M.W., Mose, L., Fort, R., Ruben, R., 2010. The impact of certification on smallholder coffee farmers in Kenya: The case of “UTZ” certification program. Paper presented at African Association of Agricultural Economists (AAAE). Cape Town, South Africa.

Karanja, A., Kuyvenhoven, A., Moll, H., 2003. Economic Reforms and Evolution of Producer Prices in Kenya: An ARCH-M Approach’, African Development Review, 15: 2–3, 271–96.

Katrakilidis, C., Trachanas, E., 2012. What drives housing price dynamics in Greece: New evidence from asymmetric ARDL cointegration. Economic Modelling, 29(4), 1064-1069.

Kibret, H., Wakiaga, J., Admit, W.Z., 2015. “Ethiopia 2015”, in African Econmic Outlook Country Notes, retrieved from http://www.africaneconomicoutlook.org/en/country-notes/ethiopia.

Kilima, F.T.M., 2006. Are price changes in the World Market transmitted to markets in less developed countries? A case study of sugar, cotton, wheat and rice in Tanzania. IIIS Discussion paper 160, institute for international integration studies.

Krivonos, E., 2004. The Impact of Coffee Market Reforms on Producers' Prices and Price Transmission. Policy Research Working Paper No. 3358. Washington, DC: World Bank.

Krueger, A.O., Schiff, M., Valdes, A., 1988. Agricultural invectives in developing countries: Measuring the effect of sectoral and economy wide policies, World Bank Economic Review, 2:255-271.

Kufa, T., 2012. Recent coffee research development in Ethiopia, Presentation at the “Ethiopian Coffee Export Conference: Strengthening the Legacy of Our Coffee, Addis Ababa.

Lazzarini, S.G., Chaddad, F.R., Cook, M.L., 2001. Integrating Supply Chain and Network Analysis: The Study of Netchains. Journal on Chain and Network Science 1(1), 7-22.

Le Goulven, K., 2001. Institutions and price transmission in the Vietnamese hog market. International Food and Agribusiness Management Review, 2(¾), 375–390.

Lele, U.J., 1972. Food Grain Marketing in India: Private Performance and Public Policy. Indian Economic Review, New Series, 7(2), 224-226.

Lemessa, D., 2000. Field Assessment Report: Jimma Zone of Oromia Region. UN-Emergencies Unit for Ethiopia.

Leung, L., 2014. Eroded Coffee Traceability and Its Impact on Export Coffee Prices for Ethiopia (No. 2014-04). JDI Executive Programs.

Li, J.F., Lin, Z.X., 2015. The impact of sales tax on economic growth in the United States: an ARDL bounds testing approach, Applied Economics Letters, 22:15, 1262-1266. DOI:10.1080/13504851.2015.1023933

Li, X., Saghaian, S., 2013. The Dynamics of Price Transmission in the Presence of a Major Quality Differential: The Case of Colombian Milds and Vietnamese Robusta Coffee Beans. Journal of Agribusiness, 1(31), 181-192.

Lohano, H.D., Mari, F.M., 2006. Testing Market Integration in Regional Onion Markets of Pakistan: Application of Error Correction Model in the Presence of Stationarity, International Research Journal of Finance and Economics, 1: 89-97.

Love, R., 2001. The Ethiopian Coffee Filière and Its Institutions. Cui Bono? Review of African Political Economy, *28(88),* 225–40.

Maro, G., Mrema, J., Msanya, B., Teri, J., 2014. Farmers’ perception of soil fertility problems and their attitude towards integrated soil fertility management for coffee in

northern Tanzania. Tropical and Subtropical Agroecosystems, North America, 17, apr. 2014. Available at: <http://www.ccba.uady.mx/ojs/index.php/TSA/article/view/1485>.

Mavrotas, G., Kelly, R., 2001. Old Wine in New Bottles: Testing Causality Between Savings and Growth. The Manchester School, 69: 97–105. doi: 10.1111/1467-9957.69.s1.6

McKenzie, D., Yang, D., 2010. “Experimental Approaches in Migration Studies.” Policy Research Working Paper Series No. 5395.Washington, DC:World Bank Migration Policy Institute, MPI Data Hub. Retrieved from http://www.migrationinformation.Org /datahub /re mittances.cfm.

Meijerink, G.W., Alemu, D., Van Der Mheen-Sluier, J., Wijnands, J., 2010. Institutional innovation in African markets: can commodity exchanges address sustainability issues? Paper prepared for presentation at the 119th EAAE seminar ‘Sustainability in the food sector: rethinking the relationship between the agro-food system and the natural, social, economic and institutional environments’, Capri, Italy.

Mengistie, G., 2011. Intellectual Property as a Policy Tool for Development the Ethiopian Fine Coffee Designations Trade Marking & Licensing Initiative Experience.

Meuwissen, M.P.M., Velthuis, A.G.J., Hogeveen, H., Huirne, R.B.M., 2003. Traceability and Certification in Meat Supply Chains. Journal of Agribusiness, 21, 167–81.

Mezlekia, W., 2011. Ethiopia: Operation “bulk coffee” busted. Poor Farmers. Web log post, 22 December. Available at: http://nazret.com/blog/index.php/2011/12/22 /ethiopia-operation-bulk-coffee-busted?blog=15.

Mezui, C.A.M., Rutten, L.S., Sekioua, J., Zhang, M.M., N’Diaye, N., Kabayane, Y., Arvantis, U. D., Nekati, B., 2013. Guidebook on African Commodity and Derivatives Exchanges. African Development Bank, Tunis.

Milas, C., Otero, J., Panagiotidis, T., 2004. Forecasting the spot prices of various coffee types using linear and nonlinear error correction models. International Journal of Finance and Economics, 9(3), 277–288.

Ministry of Finance and Economic Development (MoFED), 2009. Ethiopia: Building on Progress: A Plan for Accelerated and Sustained Development to End Poverty (PASDEP). Annual Progress Report 2007/08. MOFED Addis Ababa.

Minten, B., Tamru, S., Kuma, T., Nyarko, Y., 2014. Structure and performance of Ethiopia’s coffee export sector. EDRI-EFPRI Working Papers (66). IFPRI-Addis Ababa.

Mofya-Mukuka, R., Abdulai, A., 2013. Effects of Policy Reforms on Price Transmission in Coffee Markets: Evidence from Zambia and Tanzania, Food Security Collaborative Working Papers 171870, Michigan State University, Department of Agricultural, Food, and Resource Economics.

Mutuc, M., Rejesus, R.M., Yorobe, Jr.J.M., 2013. Which farmers benefit the most from Bt corn adoption? Estimating heterogeneity effects in the Philippines. Agricultural Economics, 44(2), 231–239.

Narayan, P., 2005. The saving and investment nexus for China: evidence from cointegration tests. Applied Economics, 37(17), 1979–1990.

Negassa, A., 1998. Vertical and spatial integration of grain markets in Ethiopia: Implications for Grain Market and Food Security Policies. Working paper presented at the grain market research project of the ministry of economic development and cooperation, Ethiopian, Addis Ababa.

Negewo, A., 1993. A review of coffee marketing structure in Ethiopia. Addis Ababa, Ethiopia (unpublished).

Nelson, C.R., Plosser, C., 1982. Trends and Random Walks in Macroeconomic Time Series, Journal of Monetary Economics, 10, 139-162.
Nielsen, H.B., 2005. Non-stationary time series, cointegration and spurious regression. Retrieved October 2011, from http://www. econ. ku.dk/metrics/Econometrics 2_05_II/ Slides/10cointegration_2pp. pdf
Nigussie, G., 2011. Marketing Information Operation in Ethiopia with special reference to the Ethiopia Commodity Exchange (ECX) Coffee Trading. Master Thesis Submitted to Swedish University of Agricultural Sciences.
Onis, Z., Senses, F., 2005. Rethinking the emerging post-Washington consensus. Development and Change, 36(2), 263-290.
Opara, L.U., 2003. Traceability in agriculture and food supply chain: a review of basic concepts, technological implications, and future prospects. Food Agriculture and Environment, 1 (1), 101–106.
Opara, L.U., Mazaud, F., 2001. Food traceability from field to plate. Outlook on Agric. 30(4), 239-247.
Otero, J., Milas, C., 2001. Modelling the spot prices of various coffee types. Economic Modelling, 18(4), 625–641.
Palaskas, T., Harris –White, B., 1993. Testing Market Integration: New Approach with Case Material for the West Bengal Economy. Journal of Development Studies, 30 (1), 1-57.
Paul, I., 2011. An assessment of the opportunities and challenges of the Ethiopian commodity exchange. Journal of Sustainable Development in Africa, 13(1), 1520-5509.
Peltzman, S., 2000. Prices Rise Faster than They Fall. Journal of Political Economy, 108(3), 466-502.
Pesaran, M.H., Shin, Y., 1996. Cointegration and speed of convergence to Equilibrium. Journal of Econometrics, 71(1-2), 117-143.
Pesaran, M.H., Shin, Y., Smith, S., 2001. Bounds testing approach to the analysis of level relationships. Journal of Applied Econometrics, 16(3), 289–326.
Petit, N., 2007. Ethiopia's coffee sector: a better or bitter future? Journal of Agricultural Change 7(2), 225-263.
Rapsomanikis, G., David, H., Piero, C., 2003. Market Integration and Price Transmission in Selected Food and Cash Crop Markets of Developing Countries: Review and Applications In Commodity Market Review 2003-2004, FAO. Rome: Commodities and Trade Division.
Ravallion, M., 1986. Testing Market Integration. American Journal of Agricultural Economics, 68(1), 102-109.
Rootcapital, 2016. Financing farm renovation Learning report; the coffee farmer resilience initiative. Retrieved from https://www.rootcapital.org.
Rosenbaum, P.R., 2002. Observational Studies. 2nd ed. New York, NY: Springer.
Rosenbaum, P.R., Rubin, D., 1985. Constructing a control group using multivariate matched sampling methods that incorporate the propensity score. The American Statistician, 39(1), 33–38.
Ruben, R., Fort, R., 2012. The impact of fair trade certification for coffee farmers in Peru. World Development, 40 (3), 570–582.
Seyoum, E., 2010. Price transmission system in Ethiopian coffee Market. Master's thesis, Department of Economics, Swedish University of Agricultural Sciences.
Shin, Y., Yu, B., Greenwood-Nimmo, M., 2011. Modelling Asymmetric Cointegration and Dynamic Multipliers in an ARDL Framework. Mimeo: University of Leeds.

Shin, Y., Yu, B., Greenwood-Nimmo, M., 2014. Modelling asymmetric cointegration and dynamic multipliers in a nonlinear ARDL framework. In Festschrift in honor of Peter Schmidt: Econometric methods and applications, edited by W. C. Horrace and R.C. Sickles. New York: Springer Science and Business Media, 281-314.

Shrestha, M.B., Chowdhury, K., 2005. ARDL Modelling Approach to Testing the Financial Liberalisation Hypothesis. Economics Working Paper Series, University of Wollongong.

Simioni, M., Gonzales, F., Guillotreau, P., Le Grel, L., 2013. Detecting Asymmetric Price Transmission with Consistent Threshold along the Fish Supply Chain. Canadian Journal of Agricultural Economics/Revue canadienne d'agroeconomie, 61(1), 37–60.

Sorensen, C., 2002. Modeling seasonality in agricultural commodity futures, The Journal of Futures Markets, 22, 393–426.

Stephens, E.C., Mabaya, E., Cramon-Taubadel, S.V., Barrett, C.B., 2012. Spatial Price Adjustment with and without Trade. Oxford Bulletin of Economics and Statistics, 74(3), 453–469.

Stigler, G., Sherwin, R., 1985. The extent of the market. Journal of Law and Economics, 28(3), 555–585.

Stock, J. H., Watson, M.W., 1996. Evidence on Structural Instability in Macroeconomic Time Series Relations, Journal of Business and Economic Statistics, 14:11-29.

Stuart, E., 2010. Matching Methods for Causal Inference: A Review and a Look Forward. Statistical Science, 25(1), 1-21.

Subervie, J., 2011. Producer price adjustment to commodity price shocks: An application of threshold cointegration. Economic Modelling, 28(5), 2239-2246.

Tamiru, S., 2006. Spatial Integration of White Wheat Markets in Ethiopia: Along with Improvements in Transport Infrastructure. Master Thesis Submitted to the School of Graduate Studies of Addis Ababa University, Addis Ababa.

Tamru, S., Minten B., 2016. Value Addition and Processing by Farmers in Developing Countries: Evidence from the Coffee Sector in Ethiopia. Invited poster presented at the 5th International Conference of the African Association of Agricultural Economists, September 23-26, 2016, Addis Ababa, Ethiopia.

Technoserve, 2013. The coffee initiative, phase one final report. Retrieved from http://www.technoserve.org/files/downloads/coffee-initiative-phase-one-final-report. pdf.

Tefera, A., 2015. Ethiopian coffee annual report. Global agricultural information network report.

Tefestewold, B., 1995. Studies on Colletotrichum population of Coffea arabica L. in Ethiopia and evaluation of the reactions of coffee germplasms. Doctoral Dissertation. Hohen Landwirtschaftlichen Fakultat der Rheinschen Friedrich- Wilelms-Universität Zu Bonn. p. 23.

Tilahun, D., 2011. The Effectiveness of Marketing Communication Channels: The Case of Ethiopia Commodity Exchange. Master Thesis Submitted to the School of Graduate Studies of Addis Ababa University, Addis Ababa.

Toda, H.Y., Yamamoto, T., 1995. Statistical inference in vector autoregressions with possibly integrated process. Journal of Econometrics, 66(1-2), 225–250.

Todaro, M.P., Smith, S.C., 2006. Economic development 5th edition, Pearson education limited, USA.

Tsegaye, Y., 2001. Coffee-Enset-livestock interaction for sustainable livelihood in the Sidama area of Southern Ethiopia. Agric. Tropics Subtropics, 102 (2), 119–1311.

Tullu, D., 2008. Coffee production and marketing in Oromia Regional State. In: Proceedings of a National Work Shop Four Decades of Coffee Research and Development in Ethiopia, EIAR, Addis Ababa, Ethiopia. pp.382-389.

Ubilava, D., 2012. El Niño, La Niña, and world coffee price dynamics. Agricultural Economics, 43(1), 17–26.

USAID, 2010. Ethiopian Coffee Industry Value Chain Analysis Profiling the Actors, Their Interactions Costs Constraints and Opportunities, Chemonics International.

Valkila, J., 2009. Fair trade organic coffee production in Nicaragua-sustainable development or a poverty trap? Ecological Economics, 68 (12), 3018–3025.

Van Der Vossen, H.A.M., 2005. A Critical Analysis of the Agronomic and Economic Sustainability of Organic Coffee Production. Experimental Agriculture, 41, 449-473.

van Rijsbergen, B., Elbers, W., Ruben, R., Njuguna, S.N., 2016. The ambivalent impact of coffee certification on farmers' welfare: A matched panel approach for cooperatives in central Kenya. World Development, 77, 277–292, doi: 10.1016/j.worlddev.2015.08.021.

Verhofstadt, E., Maertens, M., 2014. Can agricultural cooperatives reduce poverty? Heterogeneous impact of cooperative membership on farmers' welfare in Rwanda. Appl. Econ. Perspect. Policy, 1–21.

Weldesenbet, B., Sualeh, A., Mekonin, N., Indris S., 2008. Coffee Processing and Quality Research in Ethiopia. In: Proceedings of a National Work Shop Four Decades of Coffee Research and Development in Ethiopia, EIAR, Addis Ababa, Ethiopia. pp. 307-316.

White, H., Leavy, J., 2001. Economic Reforms and Economic Performance: Evidence from 20 Developing Countries. European Journal of Economic Research, 2 (13), 120-43.

WIPO, 2009. The Coffee War: Ethiopia and the Starbucks Story. Retrieved from http://www.wipo.int/ipadvantage/en/details.jsp?id=2621.

Woldemariam, T., 2015. Environment and Coffee Forest Forum Coffee : Ethiopia ' s Gift to the World The traditional production. Retrieved from http://www.naturskyddsforeningen

Wolde-Rufael, Y., 2005. Energy demand and economic growth. Journal of Policy Modeling, 27(8), 891–903.

Wooldridge, J.M., 2002. Econometric Analysis of Cross Section and Panel Data. MIT Press Cambridge, MA.

Worako, T.K., Alemu, Z.G., Goshu, G.A., 2010. Spatial Integration of Coffee-Growers Markets in Ethiopia. Proceedings of the Seventh International Conference on the Ethiopian Economy, Ethiopian Economic Association, 245-266.

Worako, T.K., Masaparisi, A., Lanos, B., 2014. Analysis of price incentives for coffee in Ethiopia. Technical notes series, MAFAP, FAO, Rome.

Worako, T.K., Van Schalkwyk, H.D., Alemu, Z.G., Ayele, G., 2008. Producer price and price transmission in a deregulated Ethiopian coffee market. Agrekon, 47(4), 492-508.

World Bank, 2014. Third Ethiopia Economic Update: Strengthening Export Performance through Improved Competitiveness. Washington, DC. Retrieved from https://openknowledge.worldbank.org/handle/10986/20026.

Xavier, A., 2011. Market Reform and Its Impact on the Price Transmission in the Coffee Supply Chain: A Case Study of Colombia, Ghana and Ivory Coast. Master's thesis, Cornell. Retrieved from http://www.temoa.info/es/node/400565.

Xie, Y., Brand, J.E., Jann, B., 2011. Estimating heterogeneous treatment effects with observational data (PSC Research Report No. 10–729). Ann Arbor: Population Studies Center, University of Michigan.

Curriculum Vitae

Tinsae Demise

Dept. Agricultural Economics, Ghent University, Coupure Links 653, 9000 Gent, Belgium,
Email: TinsaeDemise.Handino@ugent.be, tinsaebaby@gmail.com

Tinsae Demise obtained his bachelor degree in Agricultural resource economics and management from Hawassa University in Ethiopian (2003 to 2006), and master degree in Agricultural Economics from Haramaya University in Ethiopian (2006 to 2008). He worked as a lecture in Jimma University in Ethiopia (2008 to 2012). In February 2012, Tinsae Demise got a grant from NUFFIC-NICHE ETH-019 and started his PhD study at the Department of Agricultural Economics, Faculty of Bioscience Engineering, Ghent University, Belgium, under the guidance of Prof. Marijke.DHaese and Prof. Wim Verbeke.

Teaching experience (Jimma University, 2008 to 2012)

- Farm management
- Agricultural marketing
- Development Economics
- Research methodology
- Supervising seminar and senior project paper for undergraduate students

Participation on symposium or conference

- 18th PhD Symposium Agricultural and Natural Resource Economics, organized by the Belgian Association of Agricultural Economists (BAAE).

Supervision of MSc student thesis

- Teff value chain analysis in Becho and Dawo districts of south west Shewa, Ethiopia

- Hedonic price analysis of indigenous goat traits in Afar region, north east Ethiopia

- Value chain analysis of organic honey in Sheka zone of southwestern Ethiopia; case of Masha district

Reviewed contributed papers submitted for the XV EAAE Congress in Parma, Italy.

- Rural income dynamics: Understanding poverty and inequality changes in rural Peru
- The Competitiveness of South African Pears regarding with the main clients of European Union
- Analysis of oligopolistic behavior of Kazakh and Russian exporters in the South Caucasus wheat market

Journal articles (Published)

Demise, T., Natanelov, V., Verbeke W., & D'Haese, M., 2016. Empirical Investigation into Spatial Integration Without Direct Trade: Comparative Analysis Before and After the Establishment of the Ethiopian Commodity Exchange, The Journal of Development Studies, DOI: 10.1080/00220388.2 016.1187722

Gobena, E., Goshu, D., Demise, T., Kenea, 2016. Determinants of market participation and intensity of marketed surplus of teff producers in Bacho and Dawo districts of Oromia State, Ethiopia. Journal of Development and Agricultural Economics 5(2):020-032.